# THE ECONOMICS OF SHIPYARD PAINTING,

# PHASE II:

# (OF THREE PHASES)

# BID STAGE ESTIMATING

DECEMBER 1988

U.S. DEPARTMENT OF TRANSPORTATION

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# FORWARD

This research project is being performed under the National Shipbuilding Research Program, specifically under the purview of Panel SP-3, Surface Preparation and Coating, of the Ship Production Committee of SNAME. The report covers the second phase (second year) of a three phase (three year) effort that examines The Economics of Shipyard Painting. The second year resolves the problem of generating a timely bid stage painting estimate that utilizes historical data.

Mr. Gary Higgins of Peterson Builders, Inc. and Mr. Daryl George of Insight Industries, Inc. (formerly of peterson Builders, Inc.) serve as Project Manager and Principal Investigator, respectively. In addition, University of Wisconsin - Platteville student intern Kevin Eulgen provided the necessary data collection and computer programming support. Mr. Jim Ruecker, Chairman of Panel SP-3 during the Project, served as the Research and Development Program Manager. National Steel and Shipbuilding Company (NASSCO) has responsibility of technical direction of the project and publication of the final report.

We appreciate the support that Maritime Administration has given toward this project. We also wish to express special thanks to the private and U.S. Naval Shipyards that provided critical feedback concerning our project approach. Appendix A provides a listing of the companies and individuals who contributed to the development of this project.

# THE ECONOMICS OF SHIPYARD PAINTING

## (PHASE II)

## EXECUTIVE SUMMARY

The first phase of this three phase effort dealt with identifying the costs of painting in the shipyard. The surface preparation and coating process was broken down into its respective activities and it was discovered that the Paint Department did a lot more than just lay paint. In fact, 84% of the time the Paint Department personnel were performing support operations.

Phase II looks at how the additional operations involved in laying paint can be organized and incorporated into an automated bid estimating process.

Centuries have passed and the same techniques of estimating are still being utilized. Contracts are compared to past work and an estimate is extrapolated. This was sufficient when contracts were plenty, but in todays market such estimates can end a company's era. Unfortunately, this type of estimating is all too common in the non-repetitive manufacturing environment.

This report presents a bid estimating program that is presented not as a panacea, but as an estimating tool. The program performs all the calculations and totaling required to generate the estimate. The program also maintains the historical data that is used to perform past contract comparisons. The bidder is left to do what he does best: provide management with a detailed estimate that can be carefully scrutinized. Consequently, management can carefully review the bid and the data that was used in its development. Only then can management respond with meaningful questions about the bid. To expect more with less information is a dangerous situation and often creates confusion and unmanageable budgets.

The program has been developed in a generic format and thus, can be used by most any yard. It has been reviewed by new construction yards and repair facilities. The program is

presented in a skeletal version. The more information the user enters, the better the program will reflect the respective facility.

Included in the report is a users manual complete with instructions on how to install the program and create bid estimates. Help screens are provided.

It is time that the innovative statistical techniques developed in this country be used in U.S. Shipbuilding. Without change, future shipbuilding could be non-existent. With change, the competitive market will be lead by U.S. Shipbuilding and U.S. concerns.

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# THE ECONOMICS OF SHIPYARD PAINTING

## (PHASE II)

## 1.0 INTRODUCTION

Phase I of "The Economics of Shipyard Painting" discussed the costs of painting a vessel. The report explained in detail direct and indirect costs that typical shipyards experience during the coating process. The study emphasized the importance of not oversimplifying the cost drivers. Too often, the expense of painting is thought to be only the cost of the paint and the application time involved. Nothing could be further from the truth as was pointed out in Phase I.

It was identified in Phase I that a very small portion of time can be attributed to the laying of paint. The Auxiliary Rescue Salvage Vessel (ARS) in Phase I averaged only 16%. Similarly, the material costs experienced in the Paint Department only accounted for 63% of the total Paint Department material bill.

If a person responsible for developing the bid estimates assumes that painting costs depend primarily on the cost of paint and an associated labor rate, the company could be left with some very unforgiving low estimates.

This conclusion might lead an individual to conclude that the answer must lie in identifying ALL the costs during the bid stage development process. Consequently, one would assume the indirect painting costs dealing with labor and materials would not be missed. This technique may very well provide the best estimate, but it also would be very time consuming. A company cannot afford to invest this amount of time during a bid development if it expects to promptly answer the RFP.

Traditionally, the bid stage estimate process is often fast and furious and demands quick and decisive action. The details of the bid must be disseminated quickly and reviewed by many individuals. Historical data must be reflected upon and comparisons made wherever appropriate. Calculations need to be performed, aggregated, and submitted to upper management at a record pace. There is often little or no time to perform extensive research.

After the bid process has ended, most individuals involved will breath a sigh of relief. But there are a few that begin to wonder whether the right comparisons were made, whether enough material was estimated, or whether more time could have been spent looking at past contract data. Although common, the action to pursue to resolve these types of concerns has rarely been addressed.

This report was requested by the SP-3 Surface Preparation and Coating Panel in response to these most uncomfortable and lingering questions. This study addresses these problems by making use of an automated bid stage estimating program. The program makes it possible for the user to reflect upon tremendous amounts of historical data, provides a step by step approach to the bid development process, and performs all of the necessary calculations with speed, consistency, and reliability.

The remainder of this report discusses the manner in which the estimates were developed, how the estimates were incorporated into the bid estimating program, and how it was used at Peterson Builders, Inc. (PBI) on several “real life” bid development drills. This report also includes a working copy of the program and a complete users manual.

## 2.0 BID ESTIMATING AUTOMATION

The idea of automating the bid estimating process isn’t new. In fact, bid estimators have been automating for years. For example, the use of copying machines and the use of calculators were actually forms of automation. The term automation according to the dictionary is defined as:

> “automation 1: the technique of making an apparatus, a process, or a system operate automatically.”

As can be seen by the definition, bid estimating automation has been occurring. The only thing new presented in this study is the use of the computer.

### 2.1 ESTIMATING PROBLEMS

Further automation of the bid estimating process is desperately needed. During the study it became evident that the bid process was plagued with some very serious problems. As mentioned in the introduction, the bid development period is often very hectic, and organization is often strived for

but rarely attained. Although this may seem short sighted on the part of the bidder, the fact is that many bids do not evolve into permanent work and thus, the level of effort is often curtailed due to justifiable worries about spending money that will have no return.

In addition, large bids require tremendous amounts of manpower. Consequently, the top producers are often recruited from both the white and blue collar work force. Thus, the yard suffers having its best people away from their usual positions. It is easy to see that the less time this process takes, the better.

The following paragraphs will explain several other areas that plague the bid estimating process.

### 2.1.1 EMPLOYMENT TURNOVER

Employment turnover can have a very adverse effect on the bid estimating process. More than once PBI (and probably most yards) has experienced the agony of losing bid expertise as employees retire, resign or move to other areas of the company. As turnover occurs, Years of experience can be lost with little or no knowledge of the actual-cost that has been incurred.

As costly as it may seem, the company has just begun to pay. The real tragedy begins when the employee assigned to take over the position tries to use the old bits and pieces that he/she discovers. As the new employee continues to develop bids, he/she slowly fills in the gaps that were missing and eventually (after years of struggle) begins to develop competitive bids that reflect the actual work. Inevitably, the bid estimator leaves and the whole process starts over again.

The program that is presented in this study is aimed at eliminating this problem or greatly reducing it by organizing the bid development process in a step-by-step approach that can routinely be handed down to new estimators.

### 2.1.2 PRODUCTION CHANGES

As the production environment changes, it is imperative that the bid estimating factors be adjusted respectively.
It is inevitable that new machinery and equipment will be installed, processes will be altered, and materials will be improved. All of these changes will significantly affect the

bid estimating factors. One might assert that production improvements can only help the firm. This is true for in-house work, but in the case of bid estimating, failing to incorporate the reduction in the bid estimating factors could overprice a bid, and the yard could be left pricing itself out of the market.

The system proposed in this report eliminates this type of problem by allowing the user to update the estimating factors. Thus, the bidder can continually keep step with production enhancements.

### 2.1.3 UNTIMELY ESTIMATE

As was mentioned in the introduction, the bid development process is a very hectic time period. Consequently, the bids must be processed in short order. In most cases, many individuals will need to review the final bid. The bid must be pulled together as quickly as possible or there won't be time for a proper review. The process of writing the bid by hand and then having it typed can be a very lengthy operation.

The proposed system eliminates this problem by generating the bid via computer. Consequently, the bid is always legible and can be reprinted in a fraction of the time as changes are incorporated into the bid.

### 2.1.4 CONSISTENT FORMAT

Nothing is more frustrating than having the format of a document constantly change.

The system proposed in this report presents a format that is easy to read and consistent no matter what type of contract is being bid.

### 2.1.5 RELIABLE CALCULATIONS

This hectic environment can also create problems in calculations. Although the bidders have the best intentions in mind, the sheer number of calculations can breed errors. Hopefully, these errors are caught in the review process, but the truth is that management rarely has the time to check each and every subtotal.

The bidding system presented in this report will perform these calculations. Consequently, the bidder is only held

responsible for checking the theories that drive the equations.

### 2.1.6 PROBLEM SUMMARY

As expected, the bid estimating Process is far from perfect. It has worked for many years, but it is about time that today's technology was incorporated into the bidding process. As described above, there are many advantages in automating the bidding process. The reader might wonder why, if all of these benefits are to be realized, why didn't shipyards automate with computers years ago? Simply, the art of bidding is not very repetitive, and computers were thought to excel in only highly repetitive areas.

## 2.2 DISJOINING THE PAINT ESTIMATE

The original intent of the program was to address the cost of paint as a percentage of the total cost of the surface preparation and coating cost. Consequently, the paint estimate would be handled the same as the rest of the Paint Department materials. This approach was changed at an SP-3 meeting held in Sturgeon Bay, WI, in June of 1987. It was agreed by the panel that the importance of paint and its respective cost could have a significant impact on the reliability of the bid if not handled at a more detailed level.

In response to this request, it was decided that the paint material estimate would be developed entirely separate of the labor estimate and would be more dependent on the type of paint and the roils at which the paint was being applied.

## 2.3 PREPARING THE ENVIRONMENT

The manner in which paint labor data is collected at PBI is not mandatory for use of the bid estimating program. The bid estimating program presented in this study was developed to work in many labor collection environments. Whether a yard collects paint labor by compartment, block, or zone, the program will still function. What is important is that the data collection effort is consistent and portrays a true picture of the work being performed.

## 2.4 MODIFYING THE LABOR SYSTEM

In order to provide this consistency, it was necessary for PBI to alter their labor collection effort in the Paint

Department to include the compartment number. In most yards, labor information is collected daily in order to satisfy primarily yard's accounting needs. Until a few years ago, this was an acceptable practice. But today, management is more demanding of the facility's data and requests that it also provide planning and scheduling information, machine utilization, and why not? . . . estimating data.

In Phase I of The Economics of Shipyard Painting it was learned that the addition of several production related fields could provide first line supervisors with valuable shop floor feedback. One of the fields that was added was the compartment, a very important field since the compartment is considered the Paint Department's product. Please refer to the Phase I report for further explanation of why the compartment was chosen. Once the change was accomplished and data collection by compartment became the rule rather than the exception, the process of categorizing the labor returns to feed the estimating program was greatly enhanced. Again, collecting information by compartment was unique to PBI. It is important to remember that the level of detail at which the labor data is collected should parallel the detail in the bid estimating program. In other words, if data is collected at a zone level, then the resulting bid estimating program will also reflect a zone level format.

## 2.5 REWORK DEFINED

Another area of concern in preparing the right environment is the definition of rework. Rework can actually have many different meanings dependent upon which yard a person talks to, but "A" yard can only have ONE meaning per contract.

This problem was easily overcome at PBI by developing a detailed description of rework in the Paint Department. Please see Figure 2-1. The definition was discussed with every Paint Department member. In order to improve the accuracy of the data being collected, it was extremely important that workers could recognize rework.

# 3.0 ESTIMATE DEVELOPMENT

During Phase I, collection measures were initiated that complimented the bid stage estimating phase. As mentioned above, the data collection scheme was based on the compartment. The goal was to develop an estimating technique that would prove flexible enough to adapt to varying

compartment sizes, shapes, outfitting, etc. The method chosen was a variation on an approach utilized by the U.S. Army Material Command called Quantitative Budget Analysis.

## 3.1 QUANTITATIVE BUDGET ANALYSIS

Quantitative Budget Analysis (QBA) makes use of a variety of analytical techniques to determine whether any reliable performance factors exist. QBA is actually a process. Please see Appendix C for a logic chart that describes the decisions that must take place when developing an estimating equation with QBA.

## 3.2 IDENTIFICATION OF PERFORMANCE FACTORS

The very first step in the QBA process is to select tentative performance factors. The trap that most bidders fall into when considering paint labor is that they assume that man-hours depend solely on sqft. Unfortunately, compartments can be of like size, yet labor returns might be significantly different. Thus, sqft alone is not the answer.

In order to identify the unknown performance factors, the paint leadmen and foremen at PBI were asked the following question:

> What besides sqft will prolong your duties in performing surface preparation and coating operations?

Over a dozen different performance factors were identified. The answers ranged from the number of paint types to the amount of furniture in the compartment.

The next step in the process determines whether the performance factors possess four very important selection criteria. Each performance factor must be tested.

1. Does the performance factor have a causative relationship with the independent variable? There must be a direct cause and effect relationship, i.e. an increase or decrease in the value of the performance factor must accordingly have an affect on the resources expended.

2. Is the performance factor synonymous with resources? A dependent variable disguised as a performance factor is not an indicator of production.

3. Is the data available? A performance factor will prove useless if it cannot be measured.

4. Finally, is the performance factor meaningful to the end user? The performance factor must be easily understood. If the performance factor doesn't address the work environment, its use will be limited.

After performing these tests on the performance factors, the original list was reduced to twelve.

In the event that no performance factors meet the criteria, then additional performance factors should be chosen and tested against the criteria.

## 3.3 RATING SYSTEM

Due to the fact that some of the predictors were proving difficult to tabulate, such as number of hangers, accessibility, amount of foundations, etc., it became evident that some type of rating system needed to be developed to link the labor hours to the extent of outfitting in a compartment. A rating system was developed that allowed the performance factors that were qualitative in nature to be assigned a rating number. For an example, please see Figure 3-1. Assigning numbers to degrees of outfitting allowed the performance factors to be analyzed statistically.

## 3.4 SQUARE FOOT ESTIMATES

It was known quite early in the study that sqft would be a performance factor. Consequently, the method of totalling sqft had to be resolved. Often sqft figures consist of surface area and an allowance for stiffeners, beams, etc. At PBI it was agreed that sqft would be measured only in surface area. This was done because the time allotted for painting structural members was planned to be accounted for by the remaining performance factors.

This doesn't imply that other yards must follow this method. The important point is that measuring techniques are consistent and all parties involved are aware of the standard yard policies. An allowance may still be used, but be aware that accounting for the additional effect on the dependent variable with allowances negates the need for determining a performance factor to measure the amount of stiffeners, beams, etc. Also, if an allowance factor is used, do not add a supplemental paint system to cover the stiffeners and beams

since the additional sqft estimate will automatically call for the paint that is needed. The "Double Charge" situation must always be avoided.

## 3.5 ANALYZING THE PERFORMANCE FACTORS

When analyzing data, one must remember that the goal is to develop an estimating equation that is simple to use yet provides an estimate that falls within an acceptable user-defined range. In other words, it would not be practical to use all of the performance factors that were identified. Some factors may add very little to the accuracy of the estimating equation. There may also be factors that prove redundant. In other words, there may be performance factors that measure the same characteristic but are phrased differently. The elimination of these unwanted performance factors will result in a much cleaner equation.

Through multivariate techniques, an estimating equation was developed. The resulting equation made use of four independent variables.

| DEPENDENT VARIABLE | | INDEPENDENT VARIABLES |
|---|---|---|
| MAN-HOURS | = | 24.5(MACHINERY AND EQUIPMENT FACTOR) -1-<br>24.2(PIPING FACTOR) +<br>0.27(SQFT FACTOR) +<br>36.7(ELECTRICAL PANELS FACTOR) +<br>-295.4 |

## 3.6 RATING SYSTEM PROBLEMS

Although QBA had provided an equation that had an associated level of accuracy, two major problems were uncovered. First, the rating system proved to be too subjective. Rating differences were encountered by individuals who had reviewed similar outfitted compartments. Several measures were tried to eliminate this phenomenon, but the variability could not be dismissed. The second major problem turned out to be a problem with the available bid information.

Test number three specifically asks whether the data is available. It turned out that the bid data was far less detailed than first thought. There was no feasible manner in which an individual could consistently judge the amount of

machinery, piping and equipment during the bid stage period. Several old contracts were reviewed, and it was concluded that at the very most, sqft and the type of compartment were the only information that was consistently available.

## 3.7 COMPARTMENT TYPE CATEGORIZING

Although the rating system had been labeled impractical, it clearly pointed out that sqft alone would not produce a reliable estimate. Consequently, the situation mandated that the a method be found to incorporate the compartment type into the bid estimating process.

After further analysis of the data, it became evident that the mins/sqft data began to exhibit a grouping of like compartments. Please see Figure 3-2. It was decided that a categorizing method would be used, and thus the data could be organized by compartment type.

Twenty different compartment types were identified based on the returns from the ARS vessel.

| | |
|---|---|
| CREW BERTHING | PIPE TUNNEL |
| CHILL/FREEZE | STATEROOM |
| FAN ROOM | STOREROOM |
| GALLEY | TANK |
| INTAKE/UPTAKE | VOID |
| LOCKER | WORK SHOP |
| LOUNGE & RECREATION | WET SPACE |
| MACHINERY SPACE | EXTERIOR DECK |
| OFFICE | EXTERIOR HULL |
| PASSAGE | EXTERIOR VERTICAL |

### 3.7.1 COMPARTMENT TYPE REFERENCE GUIDE

Although the technique had now been developed that made use of performance factors available during bid stage, the research team still faced the problem of subjectively looking at blue prints and classifying the compartments by type. To overcome this problem, reference guides were developed.

A Compartment Type Reference Guide (CTRG) was produced that consisted of photographs of compartment types on past contracts. The CTRGs are organized by compartment type. They provide the bidder a refresher course on past contracts. The CTRGs also provide the bidder a better opportunity to

present his/her theories with respect to a compartment's rating. Without the CTRGS, agreements on outfitting complexities would prove difficult. It is suggested that a CTRG be established for each type of contract that a yard routinely bids. At PBI, compartment type reference books were developed for both the Navy Steel and the Navy Wood contracts. The intent is to develop a CTRG for every contract PBI undertakes.

## 3.8 LABOR BREAKDOWN

Although the compartment type performance factors accounted for the majority of the labor, there were some collateral activities that could not be captured in this manner. For example, painting hardware in the shop such as brackets, clips, and hangers, proved impossible to attribute to a particular compartment. Consequently, labor in the Paint Department was divided into two categories, general and supplemental labor.

### 3.8.1 GENERAL LABOR

General labor accounts for all the labor that is expended at the erection site. All general labor operations are accounted for by mins/sqft factors. This includes operations like spraying, touchup, and taping. Duties such as shop blasting and painting assemblies, and shop blasting and painting small parts are not considered general labor at PBI. Please refer to example below.

EXCERPT FROM ~~PBI~~ STEEL CONTRACT CTRG

General Labor Coverage:

The mins/sqft estimate account for all time spent in a compartment after the first primer coat has been applied. The estimate ends once the compartment is closed.

INCLUDES:

Cleaning prior to painting a compartment and personal time.

DOES NOT INCLUDE (some are supplemental items):

Cleaning due to other trades; cleaning for ship

trials; blasting of mil scale, shop blasting small parts; shop blasting sections, panels, and assemblies; application of shop primer and first primer coat; and overhead including man-hours for the dispatcher, shop planner, maintenance person, and foreman.

NOTE: Several of the items are considered overhead by PBI and are not considered part of the Paint Department's time and material estimate. But, it is still important to be aware what is and what is not included in the estimate.

Again the author wants to stress that PBI's definition of general labor is unique to PBI. The user should develop a general labor definition that reflects the conditions in their own yard.

### 3.8.2 SUPPLEMENTAL LABOR

Supplemental labor is always accounted for as a percentage of the total labor. Again, supplemental labor can be defined to suit the circumstances of the yard, but it should be remembered that supplemental labor must account for all labor not accounted for by general labor.

### 3.8.3 OVERHEAD

At PBI, overhead is not considered part of the estimating process at the department level. However, if this is the case at a yard that is using the program, overhead can be added as a supplemental labor item. It became apparent that when a bid is aggregated, a yard will add overhead after all the department bids have been summarized. Thus, the reader will not see overhead addressed in bid estimating program examples in this study.

## 3.9 HANDLING REWORK

It is important that rework be identified in the bid so that upper management is aware of the true bottom line of an estimate. If rework is not broken out in a bid, the estimate is always vulnerable to cuts that could cause tremendous budget problems down the road. Knowing the bottom line permits management to make rational cuts in the bid if necessary. Any cuts in excess of the rework hours will mandate production processes or equipment changes. Even if

cuts are made in the area of rework, engineering studies will still be required to correct problem areas.

Since the cost of rework is often hard to track with respect to supplemental operations and material, a factor of rework was needed for each past contract. This factor is derived by dividing the total number of general hours without rework by the total number of general hours with rework. The rework factor is used throughout the estimating program. The rework factor is derived from the general hours since the general hours account for the largest amount of work performed. The larger the database that the factor is derived from, the less chance that abnormal data points will affect the rate. For example:

HISTORICAL SHIP DATABASE
general labor with rework = 210,000hrs
general labor without rework = 167,000hrs

$$(167{,}000) + (x)167{,}000 = 210{,}000 \quad \text{yielding } x = .257$$

In other words, the bidding program will add 25.7% to the labor and material estimates to account for anticipated rework.

## 3.10 PAINT MATERIALS

The paint materials are broken up into three different categories, compartment paint systems, supplemental paint systems, and supplemental material.

### 3.10.1 COMPARTMENT PAINT SYSTEMS

As mentioned earlier in the paper, it was decided that the compartment paint estimates would be calculated separately from the rest of the Paint Department materials. The paint material required is based on theoretical coverage of one gallon at 1 mil DFT, the mil thickness required, and the current cost per gallon. Typical paint systems are identified for each compartment type. These typical paint systems are then applied to the compartments that have been named and a resulting paint material estimate is derived. For example:

NEW CONTRACT DATA - Salvage Storeroom 480 sqft
typical storeroom system - 1 coat, epoxy primer, 4mils
2 coat, chlorinated alkyd, 3mils
3 coat, chlorinated alkyd, 3mils

Theoretical Coverage\Price
epoxy primer 700 sqft, $21
chlorinated alkyd 600 sqft, $26

epoxy primer
(480sqft)(4mils)($21/gal)/(700sqft/gal/mil) = $57.60
$72.40(w/25.7% rework)

chlorinated alkyd
(480sqft)(3mils)($26/gal)/(600sqft/gal/mil) = $62.40
$78.40(w/25.7% rework)

chlorinated alkyd
(480sqft)(3mils)($26/gal)/(600sqft/gal/mil) = $62.40
$78.40(w/25.7% rework)

Please refer to Appendix D for a complete listing of the equations used in the program.

### 3.10.2 SUPPLEMENTAL PAINT SYSTEMS

Supplemental paint systems consist of any paint that is difficult to link to a particular compartment or covers only special areas in a compartment. Fire retardant and vapor barrier paints, and equipment and furniture paints would be considered supplemental paint systems. In addition, special primers for plastics or metals would also be considered supplemental paint systems.

### 3.10.3 SUPPLEMENTAL MATERIAL

Supplemental material covers items such as brushes, solvents, blasting grit, etc. The user must identify the supplemental material that is unique to his/her yard.

## 4.0 THE BID ESTIMATING PROGRAM

After the data analysis had been performed it became increasinglv evident that our original intent of computerizing the bid estimating process was indeed the only answer. There seemed to be no other way that the numerous

calculations could be performed without the help of the computer. Keeping in line with a guideline put out by the National Shipbuilding Research Program, the program was developed for PC compatible micro computers.

## 4.1 SOFTWARE

The language that was chosen to write the bid estimating program in was Microsoft's QuickBASIC. The basic routines are in a compiled form to increase performance.

## 4.2 FORMAT

The program is entirely menu driven. The user may delete/add/edit at will. Two very important points to remember are the breakdown of comparable ship data and bid ship data.

> COMPARABLE SHIP DATA always refers to data that has been loaded based on past contracts. This may be data such as mins/sqft, general labor hours, supplemental material dollars, etc.
>
> BID SHIP DATA on the other hand refers to data that has been loaded with respect to a new contract that the yard is bidding.

All of the information used in the program revolves around the use of these two terms.

## 4.3 OUTPUT

The data from the program may be sent to a screen or to a printer. Please refer to Appendix E for an example of the output.

## 4.4 HELP SCREENS

Every menu in the program has a corresponding help screen. The user may choose the help option at any time while using the program.

Please refer to Appendix F for a complete users manual.

# 5.0 DEVELOPING AN ESTIMATE

Developing an estimate with the program is very systematized.

In most cases, the steps that must be taken to develop an estimate are similar to the steps that would be taken if the process were being done manually. Once a user has named a comparable ship file or bid ship file, the program will prompt him/her for input until all the data is entered.

## 5.1 ESTIMATING PROCEDURE

The point at which the bid estimating program should be used is directly after a request has been made for a department to submit a time-and-materials estimate. The bid estimating process should begin by estimating the sqft.

### 5.1.1 SQFT ESTIMATE

As mentioned earlier, the sqft estimates at PBI considered surface area alone and contained no allowances for structural members, beams, stiffeners, etc. While using the program at PBI, it seemed easiest if the process proceeded compartment by compartment. Although zones must be identified, no regard for grouping by level, or zone, need be performed by the user; the program will take care of this task automatically.

### 5.1.2 IDENTIFYING COMPARTMENT TYPES

As the sqft is totaled for each compartment, the user must also enter a compartment number, a short compartment description, a zone, and a compartment type.

The compartment type is identified by use of the CTRGs. If the user is not sure of a compartment type, enter an educated guess. The program can always be edited later when the bidder has had a chance to submit bid questions to the bid coordinator or the prospective customer.

### 5.1.3 IDENTIFYING TYPICAL PAINT SYSTEMS

The last process is to identify typical paint systems for each compartment type. It is crucial that the paint types that will be identified be loaded in the master paint menu prior to beginning the development of a bid ship file. If this is not done, the user is going to be required to enter each paint system in a much slower editing process.

The program will automatically prompt the user with each compartment type. The user will be required to enter paint types for the overhead, the bulkhead and the deck. A limit

of five paint types for a paint system has been chosen. In the event that this does not meet the number of coats, the user may combine coats of like paint types. For example, two coats of 3 roils primer may be combined into 1 coat of 6 roils. This will have no effect on the quantity of paint or the cost.

## 5.2 REPORT REVIEW

Once the data has been entered and the reports have been generated, the most important step must take place - the review. Although the program reports are very clean and neat, they shouldn't remain this way. The personnel involved in the bid should thoroughly review the estimates. Assumptions should be listed. For example, if the vessel is going to receive the final antifoulant coat at a different yard, this should be identified. If the comparable ship that the bid was based on did not have finish coats in the tank areas and the ship being bid does, then it should be noted and the additional labor and materials added. If an automated blasting line for plate has been introduced since the comparable ship was built, then accordingly the hours should be reduced to account for the increased efficiency.

As can be seen, the bid estimates generated by the program are only a starting point. The question might then be asked, why should the program be used if all of this review is necessary? The answer is that the program performs the mundane tasks, the data retrieval, the calculations and the word processing, while saving the important critique process for the bid team. It provides the user a base to work from with very little effort.

# 6.0 PROGRAM TESTING

The bid estimating program has been tested by several shipyards including new construction and repair facilities. The comments from those test yards have been reviewed and incorporated into the program.

## 6.1 PAST CONTRACTS

The first testing of the program was on past contracts at PBI. Three contracts consisting of varying types of construction were loaded into the system and reports generated. The main goal of the tests were to check

calculations and to review the format of the reports with Paint Department bidding personnel.

## 6.2 SHIPYARD TEST AND REVIEW

As mentioned earlier, the program was also tested at several shipyards. Several changes were suggested by the beta test facilities. The major change dealt with the segregation of the paint estimates from the rest of the paint materials. In addition, SP-3 panel members also requested that the bid estimate reports have the option of going to the screen or to the printer. Originally, the reports were planned for hard copy only. Finally, the base unit compartment was requested to be changed to area. This request was not made due to the natural familiarity of compartments with shipyard work. This does not mean that the compartment designation should refer to only one compartment at a time. On the contrary, the base unit compartment might also be used to identify several compartments that share the same compartment types. This was done in several live tests at PBI and resulted in saving a significant amount of time in the bid process. For example, if the situation arises where a bid ship has 20 compartments that are all classified as tanks, but each have a little different configuration, enter the group of compartments as one tank. The compartment description can be used to note the fact that the compartment is actually 20 smaller compartments of similar outfitting.

## 6.3 PROGRAM USE AT PBI

The system described in this report was actually used on three bidding situations. The program was used on two of the three. The first bidding opportunity that the system was used on was a repair contract. Since there was no historical data for removing old paint, it was necessary to add the operation as a supplemental labor item. This problem proved the flexibility of the system.

The second and third use of the system at PBI made use of the bid estimating program. The two contracts involved a research vessel and a fish processing ship. In both cases, the reports that the system turned out were clear and concise. The initial information that was typed into the system was edited at will and thus allowed the paint department to add and delete as more information was learned about the contract. In both cases, assumptions were attached to the final bid, and the entire packages were submitted to the individuals responsible for spearheading the bid effort.

## 6.4 MANAGEMENT CONCERNS

The new type of bidding process was questioned by upper management. Their concerns were justified. It is important that management always review new bid estimating techniques. Management soon realized that far more detailed information had been brought before them than ever in the past. In fact, the comment was made that it would be desirable to have all of the Departments present a total bid package as had been developed by the Paint Department.

## 6.5 TEST PERIOD SUMMARY

The test period was indeed a success. The ideas of industry had been incorporated into the program, and thus it has remained flexible enough to be used in any yard regardless of the size, makeup, or type of construction.

# 7.0 OTHER USES

Quantitative analysis need not be restricted to the Paint Department environment. This same type of analysis of identifying performance factors and then developing statistically an estimating equation can work in most any environment. In many situations, simple averaging is already being used. The sad fact is that when the analysis requires more than simple averaging, the hope of developing an estimating equation is given up. Consequently, the situation continues to be an irritant consuming valuable resources.

The same approach was used at PBI to determine estimates for the time it took to answer an engineering change notice. Possible performance factors were identified and an equation was developed. Similar to the Paint system, detailed information at the time that the production change was written was not available, and a categorizing method was utilized. The estimates were derived by categorizing the data by SWBS number. Expected minimums, maximums, averages, and medians were then developed for each SWBS number. The only difference in this system was that the estimates were being used to estimate in-house work verses new construction.

## 7.1 REPAIR WORK

The original intent of the program was for new construction. It was thought that developing the program to be used for new construction and repair would extremely complicate the

matters. On the contrary, use of the system is flexible enough to be used on one compartment or hundreds of compartments. The program has intentionally been developed in a manner that forces the user to make it unique for each shipyard. If the user works in a repair facility, then general labor and supplemental labor will probably take on a repair flavor. On the other hand, if the user comes from a small barge producing facility, then the program will similarly reflect a barge manufacturer's environment.

## 7.2 COMMERCIAL PAINTING

It is entirely possible that commercial painters could use this program for office buildings. The difference between outfitting a bedroom versus outfitting a stateroom is a very fine line.

# 8.0 SUMMARY

This report relies heavily upon the findings in Phase I. This doesn't assert that the bid estimating program is unusable if Phase I research hasn't been performed. On the contrary, the bid estimating program can be used where all that is known is the total hours expended on a contract and a rough idea of the rework. Likewise, this type of information will also produce nothing more than a very rough estimate. If the user wants to improve his/her estimating process, more time must be spent in creating the right environment and collecting reliable data as was explained in Phase I. If this is not done, the user will continually struggle with not knowing rework rates, not knowing mins/sqft by compartment type, and not knowing supplemental labor percentages. Thus, the user may never fully utilize the bid estimating program's full potential.

The interesting feature about this program is that the user can continually build his/her database. As more contracts are finished, more detailed information will be added to the database until finally a good estimating base has been established.

## DISCLAIMER

Peterson Builders, Inc. and Insight Industries, Inc. make no representations or warranties with respect to the Bid Estimating Program or the Users Manual and specifically disclaim any inferred warranties or fitness for any particular purpose.

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## REWORK DEFINITION

STEEL CONTRACTS

The intent of a steel contract pre-outfitting procedure is to have all hotwork performed prior to the primer coat such as hangers, foundations, insulation studs, etc. Upon completion of the hotwork, the compartment is to be primed and insulated. Immediately after the Insulating Department has completed their work, the first finish coat is to be applied. The application of the first finish coat is to be performed before any items are installed that require taping, such as electrical panels, light fixtures, instrumentation, etc. Finally, the finish coat of paint is to be applied only when every item that is required in the compartment is installed. Any deviation from the above mentioned procedure constitutes rework.

Use the following examples to help make decisions on what is rework and what is not. The following statements describe rework examples.

Work due to engineering item location changes (ECNs, etc.) .

Work due to added bulkheads or hull components after the first coat has applied.

Taping due to electrical panels, instrumentation, etc. that are installed before the first finish coat has been applied.

Work due to poor paint application (runs, sags, skips, etc.) .

Work due to defective vendor furnished materials.

Work due to defective equipment.

Work due to improper scheduling with respect to weather constraints.

Work due to painting out of the Planning Department's specified sequence.

Work due to damaged finish coats because of scratches, nicks, etc.

Figure 2-1.

COMPARTMENT COMPLEXITY RATING SYSTEM

- ACCESSIBILITY: 1=EXCELLENT 2=GOOD 3=ABOVE AVG. 4=AVG. 5=BELOW AVG. 6=POOR 7=VERY POOR
- LOCATION: 1=MAIN DECK 2=01 LEVEL,PLATFORM 3=02 LEVEL,HOLD 4=02 LEVEL,DOUBLE BOTTOM 5=03 LEVEL 6=04 LEVEL
- AMOUNT OF/ROOM SIZE: 1=NONE 2=FEW 3=BELOW AVG. 4=AVG. 5=ABOVE AVG. 6=MANY 7=EXCESSIVE

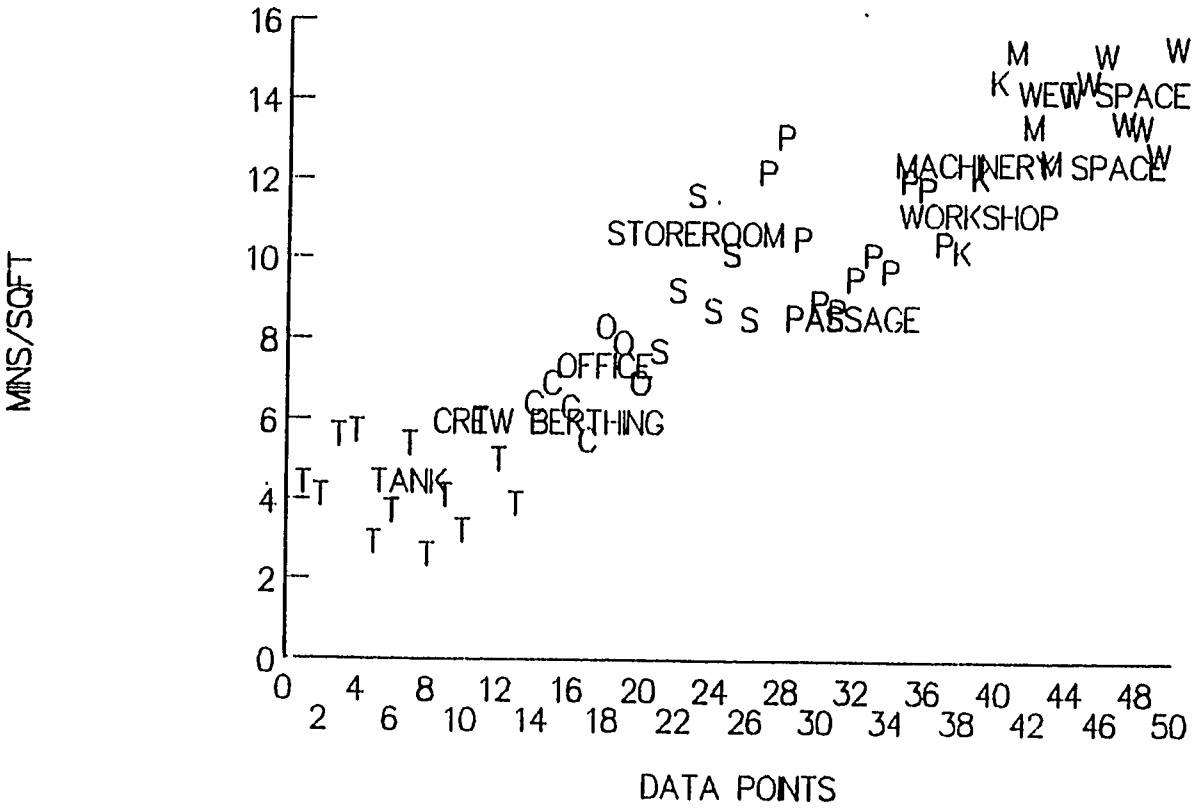
SECTION: 406 COMPARTMENT: 1-6-0-E TYPE: MS

| DATE | ACCESS | LOC | NO OF PNT TYPES | NO OF INSUL BKHDS | NO OF PNT'D BKHDS | HNGRS FONDS BRKTS | WIRES | PIP'G | ELEC PNLS | MACH EQUIP | FURN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-7 | 5 | 1 | 1 | 5 | 5 | 4 | 5 | 4 | 5 | 6 | 1 |
| 1-16 | 5 | 1 | 1 | 5 | 5 | 5 | 6 | 5 | 6 | 6 | 1 |
| 11-6 | 5 | 1 | 1 | 5 | 5 | 6 | 4 | 5 | 6 | 6 | 1 |

Figure 3-1.

# COMPARTMENT TYPE ANALYSIS

## MINS/SQFT DATA WITHOUT REWORK



# APPENDIX A

## ACKNOWLEDGMENTS AND SOURCES OF INFORMATION

The author wishes to thank those companies that provided information that was used in compiling this report:

* National Steel and Shipbuilding Company

* Long Beach Naval Shipyard

* Bay Shipbuilding Company

* Todd Pacific Shipyards Corporation, Los Angeles Division

* Pro-Line Paint Manufacturing Company

The author also wishes to thank the individuals that provided consulting services and those managers that beta tested the Bid Estimating Program:

* Mr. Rodney A. Robinson

* Mr. Phil Sands

* Mr. Paul Vickers

* Mr. Jim Fuller

* Mr. Jim Ruecker

* Mr. Kenneth Kundert

## APPENDIX B

## TERM AND DEFINITIONS

Bid ship - refers to a new contract that is about to or is in the process of being bid.

Comparable ship - refers to a past contract that the bid ship will be compared against.

CTRG - Compartment Type Reference Guide; a pictorial guide of past contracts which display the level of outfitting in compartments.

General labor - refers to all surface preparation and coating labor performed after the first primer coat has been applied.

Supplemental labor - all paint labor other than general labor. Does not include overhead.

Supplemental material - all Paint Department material other than paint.

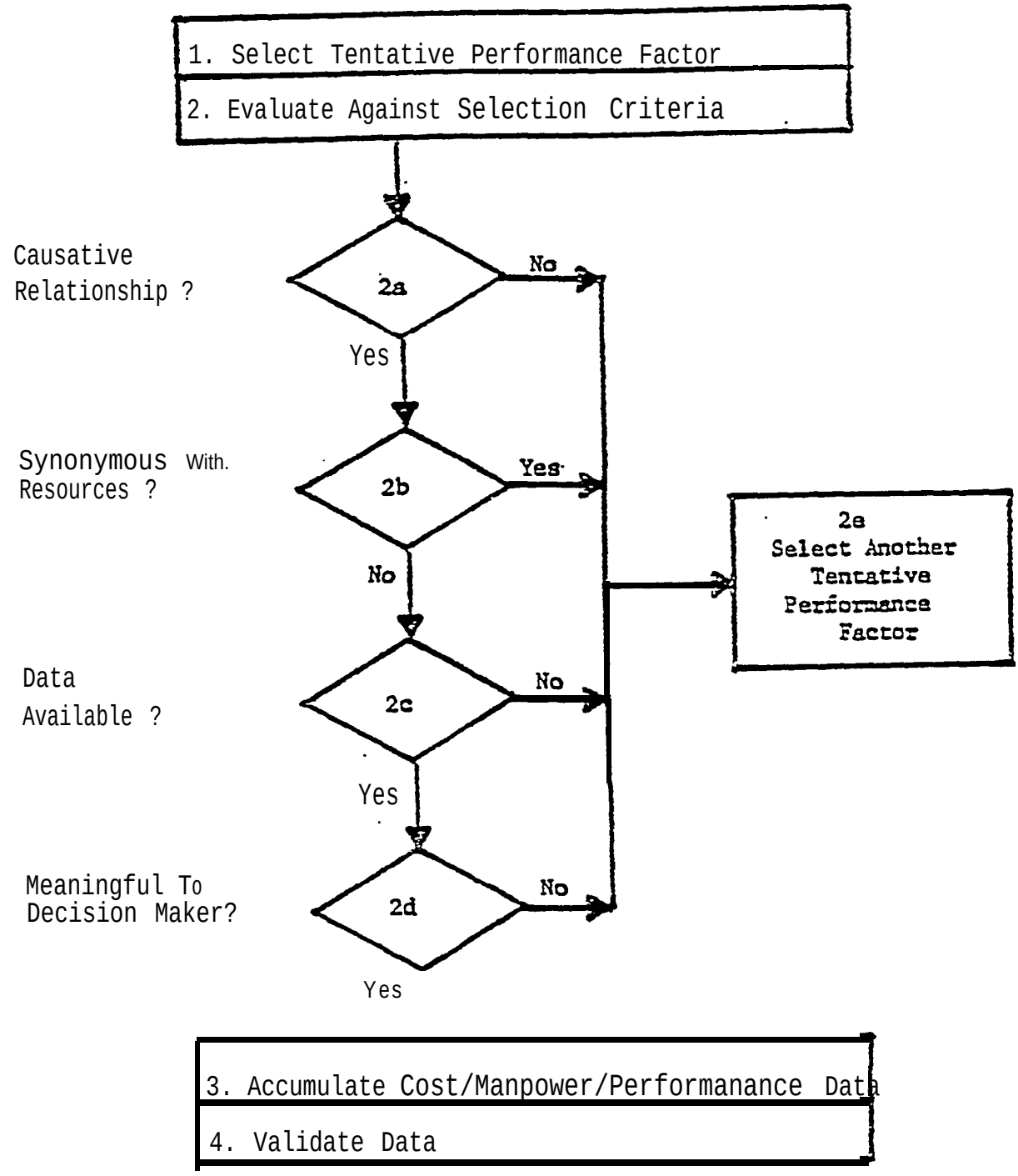
Supplemental paint system - Paint that cannot be easily attributed to a particular compartment; or paint that is used to provide special surface preparation, protection or finishes.

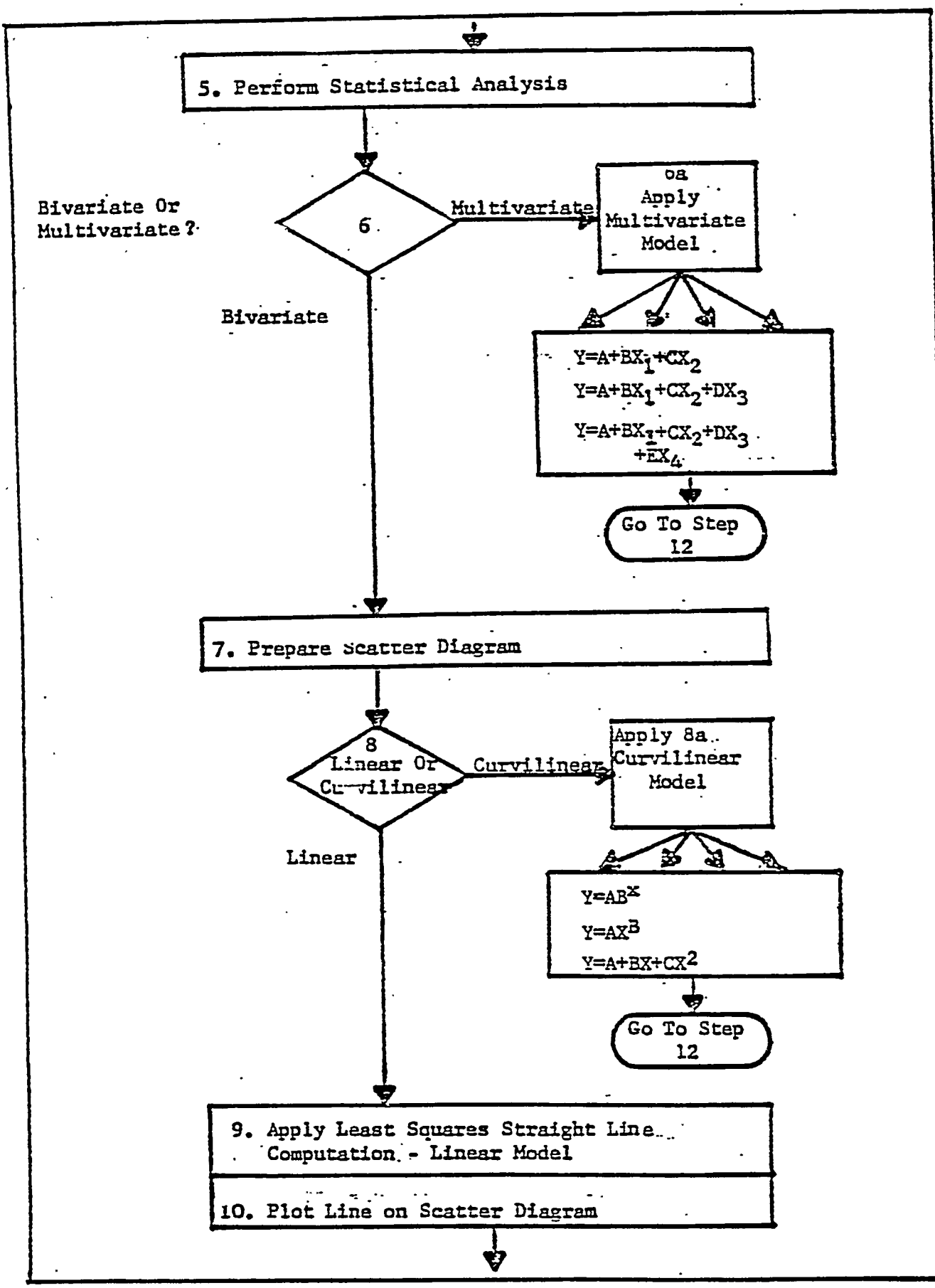
QBA - Quantitative Budget Analysis; statistical techniques used by analysts at all levels of operations in their efforts to examine the relationships between workload and resources.

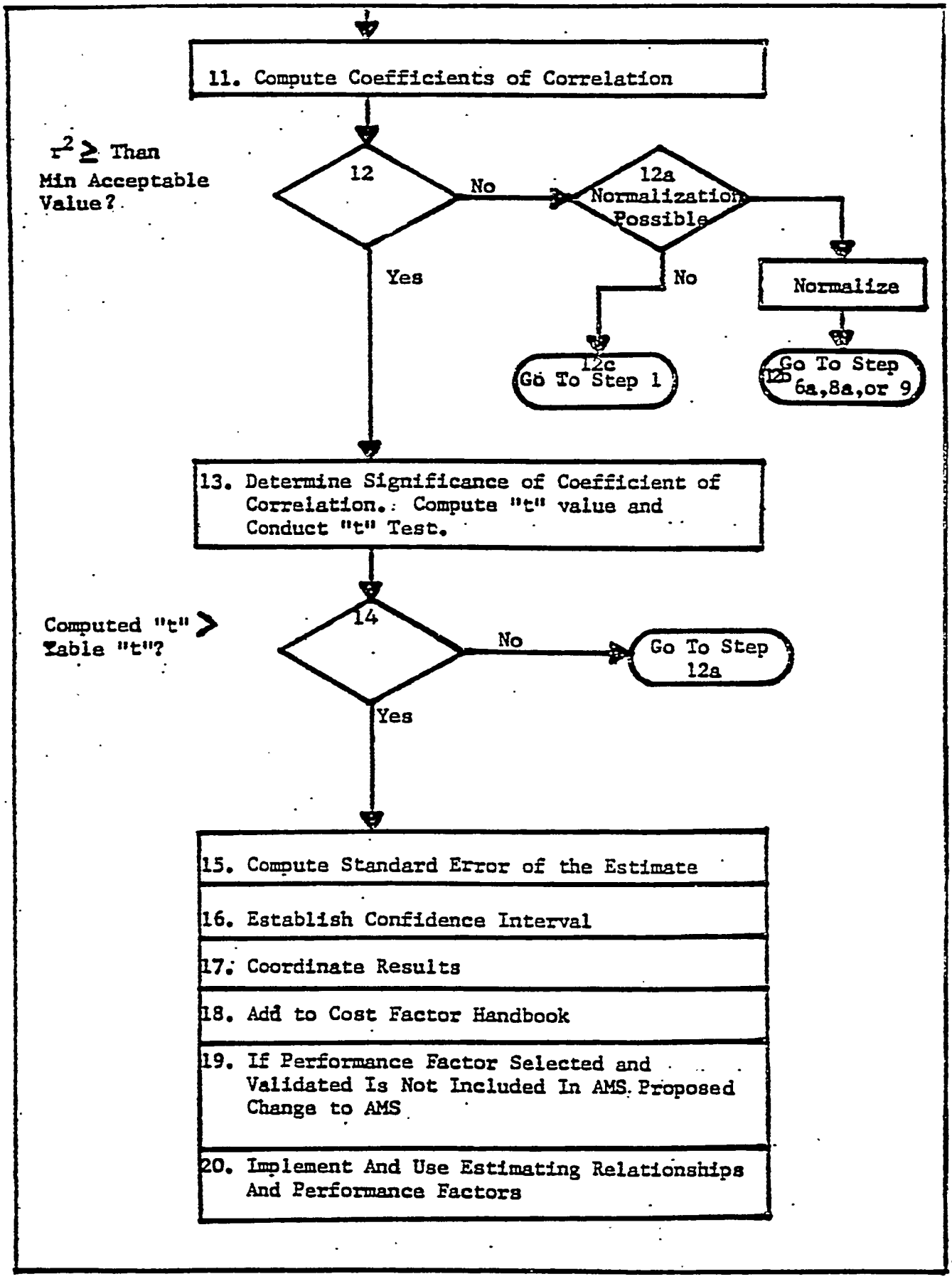
# APPENDIX C

# QBA LOGIC CHART

Logic Chart:. Performance Factor Selection and Development of Estimating Relationships




5. Perform Statistical Analysis
Bivariate Or Multivariate ?
6
Multivariate
8a
Apply Multivariate Model
Bivariate
$Y=A+BX_1+CX_2$
$Y=A+BX_1+CX_2+DX_3$
$Y=A+BX_1+CX_2+DX_3+EX_4$
Go To Step 12
7. Prepare Scatter Diagram
8
Linear Or Curvilinear
Curvilinear
Apply 8a Curvilinear Model
Linear
$Y=AB^X$
$Y=AX^B$
$Y=A+BX+CX^2$
Go To Step 12
9. Apply Least Squares Straight Line Computation - Linear Model
10. Plot Line on Scatter Diagram


11. Compute Coefficients of Correlation
$r^2 \geq$ Than Min Acceptable Value?
12
No
12a Normalization Possible
Yes
No
Normalize
12c Go To Step 1
12b Go To Step 6a,8a,or 9
13. Determine Significance of Coefficient of Correlation. Compute "t" value and Conduct "t" Test.
Computed "t" > Table "t"?
14
No
Go To Step 12a
Yes
15. Compute Standard Error of the Estimate
16. Establish Confidence Interval
17. Coordinate Results
18. Add to Cost Factor Handbook
19. If Performance Factor Selected and Validated Is Not Included In AMS Proposed Change to AMS
20. Implement And Use Estimating Relationships And Performance Factors

# APPENDIX D

## BID ESTIMATING PROGRAM EQUATIONS

NOTE: CS = COMPARABLE SHIP, BS = BID SHIP, R = REWORK
w = WITH, W/O = WITHOUT

To CALCULATE BS GENERAL LABOR HOURS WITHOUT AND WITH REWORK:

( CS MINS/SQFT/COMPARTMENT TYPE W\O R) (SQFT) / ( 60)
= (BS GENERAL LABOR HOURS W/O R)

( CS MINS/SQFT/COMPARTMENT TYPE W R) (SQFT) / ( 60)
= (BS GENERAL LABOR HOURS W R)

TO CALCULATE BS GENERAL LABOR DOLLARS WITHOUT AND WITH REWORK:

( BS LABOR HOURS W/O R) ( BS LABOR RATE)
= (BS LABOR DOLLARS W/O R)

( BS LABOR HOURS W R) ( BS LABOR RATE)
= (BS LABOR DOLLARS W R)

TO CALCULATE BS SUPPLEMENTAL LABOR HOURS WITHOUT AND WITH REWORK:

( CS SUPPLEMENTAL LABOR ITEM HOURS W/O R)
( BS TOTAL GENERAL LABOR HOURS W/O R)/
( CS TOTAL GENERAL LABOR HOURS W/O R)
= ( BS SUPPLEMENTAL LABOR ITEM HOURS W/O R)

( CS SUPPLEMENTAL LABOR ITEM HOURS W R)
( BS TOTAL GENERAL LABOR HOURS W R)/
( CS TOTAL GENERAL LABOR HOURS W R)
= ( BS SUPPLEMENTAL LABOR ITEM HOURS W R)

To CALCULATE BS SUPPLEMENTAL LABOR DOLLARS WITHOUT AND WITH REWORK :

(BS SUPPLEMENTAL LABOR ITEM HOURS W/O R) (BS LABOR RATE)
= ( BS SUPPLEMENTAL LABOR ITEM DOLLARS W/O R)

(BS SUPPLEMENTAL LABOR ITEM HOURS W R) (BS LABOR RATE)
= ( BS SUPPLEMENTAL LABOR ITEM DOLLARS W R)

To CALCULATE BS SUPPLEMENTAL MATERIAL DOLLARS WITH REWORK:

(CS SUPPLEMENTAL MATERIAL ITEM DOLLARS)
( BS TOTAL GENERAL LABOR HOURS W R) (BS LABOR RATE)/
( CS TOTAL GENERAL LABOR HOURS W R)
( CS LABOR RATE)
= ( BS SUPPLEMENTAL MATERIAL ITEM DOLLARS W R)

To CALCULATE BS SUPPLEMENTAL MATERIAL DOLLARS WITHOUT REWORK:

(BS SUPPLEMENTAL MATERIAL DOLLARS W R)/
( ( ( ( BS TOTAL GENERAL LABOR HOURS W R) -
( BS TOTAL GENERAL LABOR HOURS W/O R))/
( BS TOTAL GENERAL LABOR HOURS W/O R) ) + 1)
= ( BS SUPPLEMENTAL MATERIAL DOLLARS W/O R)

To CALCULATE BS GALLONS WITHOUT REWORK:

(BS SQFT/COMPARTMENT TYPE/SURFACE AREA) (MIL THICKNESS ) /
(THEORETICAL COVERAGE OF 1 GALLON AT 1MIL DFT)
= (BS GALLONS W/O R)

To CALCULATE BS GALLONS WITH REWORK:

( BS GALLONS W/O R) + ( BS GALLONS W/O R)
( ( (BS TOTAL GENERAL LABOR HOURS W R) -
(BS TOTAL GENERAL LABOR HOURS W/O R))/
( BS TOTAL GENERAL LABOR HOURS W/O R) )
= (BS GALLONS W R)

To CALCULATE BS GALLON DOLLARS WITH AND WITHOUT REWORK:

(BS GALLONS W/O R)(DOLLARS/GALLON/PAINT TYPE)
= (BS GALLON DOLLARS W/O R)

(BS GALLONS W R)(DOLLARS/GALLON/PAINT TYPE)
= (BS GALLON DOLLARS W R)

To CALCULATE BS SUPPLEMENTAL GALLONS WITHOUT REWORK:

(BS SQFT SURFACE AREA) (MIL THICKNESS)/
(THEORETICAL COVERAGE OF 1 GALLON AT 1MIL DFT)
= (BS SUPPLEMENTAL GALLONS W/O R)

To CALCULATE BS SUPPLEMENTAL GALLONS WITH REWORK:

(BS SUPPLEMENTAL GALLONS W/O R) +
(BS SUPPLEMENTAL GALLONS W/O R)
(((BS TOTAL GENERAL LABOR HOURS W R) -
(BS TOTAL GENERAL LABOR HOURS W/O R))/
(BS TOTAL GENERAL LABOR HOURS W/O R))
= (BS SUPPLEMENTAL GALLONS W R)

To CALCULATE BS SUPPLEMENTAL 'GALLON DOLLARS WITH AND WITHOUT REWORK :

(BS SUPPLEMENTAL GALLONS W/O R)(DOLLARS/GALLON/PAINT TYPE)
= (BS SUPPLEMENTAL GALLON DOLLARS W/O R)

(BS SUPPLEMENTAL GALLONS W R)(DOLLARS/GALLON/PAINT TYPE)
= (BS SUPPLEMENTAL GALLON DOLLARS W R)

# APPENDIX E

# SAMPLE BID ESTIMATING OUTPUT

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE 01 GENERAL LABOR HOURS ESTIMATE

12-10-1988 PAGE

| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| 01-28-01-L | SA | 884 | 109 | 124 | $2,726 | $3,C [illegible] |
| 01-41-2-L | SA | 722 | 89 | 101 | $2,226 | $2,5[illegible] |
| 01-72-1-Q | LK | 940 | 240 | 329 | $5,993 | $8,22[illegible] |
| 01-82-1-M | SO | 402 | 127 | 141 | $3,183 | $3,[illegible] |
| SUBTOTAL ..... | | 2,948 | 565 | 695 | $14,127 | $17,36[illegible] |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE 02 GENERAL LABOR HOURS ESTIMATE



| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| 02-35-2-L | PS | 1,396 | 308 | 451 | $7,690 | $11,284 |
| 02-41-2-Q | LK | 473 | 121 | 166 | $3,015 | $4,139 |
| 02-44-1-Q | FR | 2,907 | 199 | 460 | $4,966 | $11,507 |
| 1-56-0-Q | IU | 3,776 | 1,454 | 1,718 | $36,344 | $42,952 |
| SUBTOTAL ..... . | | 8,552 | 2,081 | 2,795 | $52,015 | $69,882 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE 03 GENERAL LABOR HOURS ESTIMATE



| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| 03-38-0-C | OF | 255 | 65 | 74 | $1,626 | $l,853 |
| 03-40-0-M | EV | 245 | 49 | 64 | $1,235 | $1,6 |
| 03-58-0-S | EV | 789 | 159 | 206 | $3,978 | $5,161 |
| SUBTOTAL . . . . . | | 1,289 | 274 | 345 | $6,839 | $8,6 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE EXT GENERAL LABOR HOURS ESTIMATE

12-10-1988



| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| EXTDECK | ED | 10,933 | 2,824 | 3,353 | $70,609 | $83,820 |
| EXTHULL | EH | 24,083 | 4,062 | 5,668 | $101,550 | $141,688 |
| EXTVERT | EV | 7,200 | 1,452 | 1,884 | $36,300 | $47,100 |
| SUBTOTAL . . . . . | | 42,216 | 8,338 | 10,904 | $208,459 | $272,608 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE HOLD GENERAL LABOR HOURS ESTIMATE



12-10-1988

| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| 1-53-2-Q | WK | 388 | 113 | 155 | $2,829 | $3,8[illegible] |
| 3-40-2-T | PS | 261 | 58 | 84 | $1,438 | $2,1[illegible] |
| 3-86-0-V | VD | 950 | 133 | 174 | $3,325 | $4,3[illegible] |
| 4-40-1-F | TK | 1,674 | 707 | 798 | $17,668 | $19,94[illegible] |
| 4-40-2-F | TK | 1,580 | 667 | 753 | $16,676 | $18,8[illegible] |
| SUBTOTAL | ..... | 4,853 | 1,677 | 1,965 | $41,935 | $49,12[illegible] |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE MAIN GENERAL LABOR HOURS ESTIMATE

12-10-1988 

| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| 1-14-1-L | CB | 1,446 | 289 | 337 | $7,230 | $8,435 |
| 1-33-l-L | SA | 900 | 111 | 126 | $2,775 | $3,150 |
| 1-41-0-L | LR | 2,182 | 307 | 332 | $7,682 | $8,292 |
| 1-5-0-L | Ps | 922 | 203 | 298 | $5,079 | $7,453 |
| 1-5-2-A | so | 588 | 186 | 206 | $4,655 | $5,145 |
| 1-70-1-Q | OF | 598 | 152 | 174 | $3,812 | $4,343 |
| 1-87-4-L | WS | 93 | 22 | 25 | $543 | $636 |
| SUBTOTAL . . . . . | | 6,729 | 1,271 | 1,498 | $31,776 | $37,453 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE PLATF GENERAL LABOR HOURS ESTIMATE



12-10-1988

| COMPARTMENT NUMBER | COMPT TYPE | SQUARE FEET | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|---|---|
| 2-107-1-E | MS | 5,633 | 3,305 | 6,489 | $82,617 | $162,2 |
| 2-27-2-F | TK | 199 | 84 | 95 | $2,100 | $2,3.1 |
| 3-11-0-Q | TK | 666 | 281 | 317 | $7,029 | $7,937 |
| 3-40-0-E | MS | 7,882 | 4,624 | 9,080 | $115,603 | $227,0-: |
| 2-104-3-F | TK | 241 | 102 | 115 | $2,544 | $2,8 |
| 3-68-0-E | MS | 6,922 | 4,061 | 7,974 | $101,523 | $199,35′ |
| SUBTOTAL . . . . . | | 21,543 | 12,457 | 24,071 | $311,416 | $601,7 |
| HULL TOTAL . . . . . | | 88,130 | 26,663 | 42,272 | $666,566 | $1,056,80 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
SUPPLEMENTAL LABOR ESTIMATE

12-10-1988 

| SUPPLEMENTAL LABOR NAME | LABOR HRS EST W/O REWORK | LABOR HRS EST WITH REWORK | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|---|---|
| BLAST AND PAINT ASSEMBLIES | 1,330 | 2,785 | $33,250 | $69,625 |
| BLAST AND PAINT SMALL PARTS | 630 | 1,712 | $15,750 | $42,800 |
| PRIME PLATE | 1,171 | 1,836 | $29,275 | $45,900 |
| REMOVE BLAST MEDIA | 351 | 405 | $8,775 | $10,125 |
| SUPPLEMENTAL LABOR TOTAL . . . . | 3,482 | 6,738 | $87,050 | $168,450 |
| HULL LABOR TOTAL . . . . . | 30,145 | 49,010 | $753,616 | $1,225,259 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
SUPPLEMENTAL MATERIAL ESTIMATE

2-10-1988



| SUPPLEMENTAL MATERIAL NAME | LABOR COST EST WITHOUT REWORK | LABOR COST EST WITH REWORK |
|---|---|---|
| BLAST GRIT | $4,616 | $7,318 |
| MISC | $1,653 | $2,621 |
| SOLVENT | $3,543 | $5,618 |
| SUPPLEMENTAL MATERIAL TOTAL . . | $9,812 | $15,557 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 01-28-01-L | SA | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.80 | 1.27 | $7 | $11 |
| | BULKHEAD | | | | | |
| | | 150 | 1.58 | 2.51 | $14 | $22 |
| | | 124 | 1.72 | 2.73 | $22 | $36 |
| | DECK | | | | | |
| | | 150 | 0.70 | 1.11 | $6 | $10 |
| | | LBE | 1.16 | 1.84 | $6 | $20 |
| | | LBE | 1.16 | 1.84 | $13 | $20 |
| 01-41-2-L | SA | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.70 | 1.11 | $6 | $10 |
| | BULKHEAD | | | | | |
| | | 150 | 1.12 | 1.78 | $10 | $16 |
| | | 124 | 1.22 | 1.93 | $16 | $25 |
| | DECK | | | | | |
| | | 150 | 0.70 | 1.11 | **$6** | $10 |
| | | LBE | 1.17 | 1.85 | **$13** | $20 |
| | | LBE | 1.17 | 1.85 | **$13** | $20 |
| 01-72-1-Q | LX | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.85 | 1.34 | $8 | $12 |
| | BULKHEAD | | | | | |
| | | 150 | 1.58 | 2.51 | $14 | $22 |
| | | 124 | 1.72 | 2.73 | $22 | $36 |
| | DECK | | | | | |
| | | 150 | 0.85 | 1.34 | $8 | $12 |
| | | 150 | 0.85 | 1.34 | $8 | $12 |
| | | 124 | 1.54 | 2.44 | $20 | $32 |
| 01-82-1-M | SO | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.35 | 0.56 | $3 | $5 |
| | | SMGWE | 0.63 | 1.00 | $8 | $12 |
| | BULKHEAD | | | | | |
| | | 150 | 0.93 | 1.47 | $8 | $13 |
| | | SMGWE | 1.25 | 1.98 | $16 | $25 |
| | DECK | | | | | |
| | | 150 | 0.35 | 0.56 | $3 | **$5** |
| | | SMGWE | 0.63 | 1.00 | $8 | **$12** |
| SUBTOTAL | | | | | $264 | $419 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 02-35-2-L | PS | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 1.20 | 1.90 | $11 | $1 |
| | | 124 | 1.74 | 2.75 | $23 | $36 |
| | | 124 | 1.74 | 2.75 | $23 | $36 |
| | BULKHEAD | | | | | |
| | | 150 | 2.28 | 3.62 | $20 | |
| | | 124 | 2.48 | 3.94 | $32 | $32 |
| | | 124 | 3.31 | 5.25 | $43 | $31 |
| | DECK | | | | | |
| | | 150 | 1.39 | 2.21 | $12 | $20 |
| | | 150 | 1.86 | 2.94 | $17 | $25 |
| 02-41-2-Q | LK | | | | | |
| | oVERHEAD | | | | | |
| | | 150 | 0.46 | 0.73 | $4 | $6 |
| | BULKHEAD | | | | | |
| | | 150 | 0.74 | 1.17 | $7 | $ |
| | | 124 | 0.80 | 1.27 | $10 | $17 |
| | DECK | | | | | |
| | | 150 | 0.45 | 0.72 | $4 | |
| | | 150 | 0.45 | 0.72 | $4 | $6 |
| | | 124 | 0.82 | 1.30 | $11 | $ |
| 02-44-1-Q | FR | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 1.74 | 2.76 | $15 | $25 |
| | | 124 | 2.53 | 4.01 | $33 | $52 |
| | | 124 | 2.53 | 4.01 | $33 | $5 2 |
| | BULKHEAD | | | | | |
| | | 150 | 6.66 | 10.56 | $59 | $ |
| | | 124 | 9.67 | 15.32 | $126 | $1 |
| | | 124 | 9.67 | 15.32 | $126 | $199 |
| | DECK | | | | | |
| | | 150 | 1.74 | 2.76 | $15 | $ |
| 1-56-O-Q | IU | | | | | |
| | oVERHEAD | | | | | |
| | | 111 | 1.53 | 2.42 | $17 | $ |
| | | 150 | 1.58 | 2.51 | $14 | $ |
| | BULKHEAD | | | | | |
| | | 150 | 11.16 | 17.70 | $99 | $1 |
| | | 150 | 11.16 | 17.70 | $99 | $1 |
| | DECK | | | | | |
| | | 150 | 0.57 | 0.91 | $5 | se |
| | | 150 | 0.57 | 0.91 | | |
| | | 124 | 0.62 | 0.99 | $8 | $A |
| SUBTOTAL | | | | | $875 | $1,3 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 03-38-0-C | OF | | | | | |
| OVERHEAD | | | | | | |
| | | 150 | 0.28 | 0.44 | $2 | $4 |
| | | 126 | 0.41 | 0.65 | $5 | $8 |
| BULKHEAD | | | | | | |
| | | 150 | 0.35 | 0.55 | $3 | $5 |
| | | 150 | 0.47 | 0.74 | $4 | |
| | | 124 | 0.51 | 0.80 | $7 | $ 7 |
| DECK | | | | | | |
| | | 150 | 0.26 | 0.41 | $2 | $4 |
| | | 126 | 0.38 | 0.61 | $5 | S8 |
| 03-40-0-M | EV | | | | | |
| OVERHEAD | | | | | | |
| BULKHEAD | | | | | | |
| | | 150 | 0.85 | 1.36 | | $12 |
| | | HGE | 1.57 | 2.48 | $ 8 | $35 |
| | | HGE | 1.57 | 2.48 | $22 | $35 |
| DECK | | | | | | |
| 03-58-0-S | EV | | | | | |
| OVERHEAD | | | | | | |
| BULKHEAD | | | | | | |
| | | 150 | 2.75 | 4.36 | $24 | $39 |
| | | HGE | 5.04 | 7.99 | $72 | $114 |
| | | HGE | 5.04 | 7.99 | $72 | $114 |
| DECK | | | | | | |
| SUBTOTAL . . . . . | | | | | $250 | $396 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
ZONE EXT PAINT SYSTEMS ESTIMATE

12-10-1988 

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| EXTDECK | ED | | | | | |
| OVERHEAD | | | | | | |
| BULKHEAD | | | | | | |
| DECK | | | | | | |
| | | 150 | 38.14 | 60.47 | $339 | $538 |
| | | 1139R | 971.82 | 1,540.78 | $31,098 | $49, 3C |
| EXTHULL | EH | | | | | |
| OVERHEAD | | | | | | |
| BULKHEAD | | | | | | |
| | | 150 | 84.01 | 133.19 | !$748 | $l,l8 |
| | | HGE | 153.88 | 243.98 | $2,201 | $3,489 |
| | | HGE | 153.88 | 243.98 | $2,201 | $3,489 |
| DECK | | | | | | |
| EXTVERT | EV | | | | | |
| OVERHEAD | | | | | | |
| BULKHEAD | | | | | | |
| | | 150 | 25.12 | 39.82 | $224 | $35 |
| | | HGE | 46.01 | 72.94 | $658 | $1,043 |
| | | HGE | 46.01 | 72.94 | $658 | $l,043 |
| DECK | | | | | | |
| SUBTOTAL . . . . . | | | | | $38,126 | $60,447 |

| COMPARTMENT NUMEER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 1-53-2-Q | WK | | | | | |
| OVERHEAD | | | | | | |
| | | 150 | 0.27 | 0.43 | $2 | |
| | | 124 | 0.39 | 0.62 | $5 | $4 |
| BULKHEAD | | | | | | |
| | | 150 | 0.81 | 1.28 | **$7** | $11 |
| | | 124 | 0.88 | 1.39 | **$11** | $18 |
| DECK | | | | | | |
| | | 150 | 0.28 | 0.44 | $2 | |
| | | 124 | 0.30 | 0.48 | $4 | $4 |
| 3-40-2-T | PS | | | | | |
| OVERHEAD | | | | | | |
| | | 150 | 0.18 | 0.29 | $2 | |
| | | 124 | 0.26 | 0.42 | $3 | $3 |
| | | 124 | 0.26 | 0.42 | $3 | $5 |
| BULKHEAD | | | | | | |
| | | 150 | 0.55 | 0.87 | **$5** | |
| | | 124 | 0.60 | 0.95 | **$8** | $ 8 |
| | | 124 | 0.79 | 1.26 | **$10** | $16 |
| DECK | | | | | | |
| | | 150 | 0.18 | 0.29 | $2 | $3 |
| | | 150 | 0.24 | 0.38 | $2 | |
| 3-86-O-V | VD | | | | | |
| OVERHEAD | | | | | | |
| | | 150 | 1.05 | 1.66 | $9 | $15 |
| BULKHEAD | | | | | | |
| | | 150 | 3.14 | 4.98 | $28 | $44 |
| DECK | | | | | | |
| | | 150 | 1.34 | 2.12 | $12 | $19 |
| 4-40–1-F | TK | | | | | |
| OVERHEAD | | | | | | |
| | | 150 | 1.17 | 1.85 | $10 | $16 |
| | | 150 | 1.17 | 1.85 | $10 | $16 |
| | | 104 | 2.00 | 3.17 | $30 | $48 |
| BULKHEAD | | | | | | |
| | | 150 | 3.50 | 5.55 | $31 | $49 |
| | | 150 | 3.50 | 5.55 | $31 | $49 |
| | | 104 | 5.99 | 9.50 | $90 | $143 |
| DECK | | | | | | |
| | | 150 | 1.17 | 1.85 | $10 | $16 |
| | | 150 | 1.17 | 1.85 | $10 | $16 |
| | | 104 | 2.00 | 3.17 | $30 | $48 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COSI WITH REWORK |
|---|---|---|---|---|---|---|
| 440-2-F | TK | | | | | |
| OVERHEAD | | | | | | |
| | | 150 | 1.10 | 1.75 | $10 | $1 |
| | | 150 | 1.10 | 1.75 | $10 | $10 |
| | | 104 | 1.89 | 2.99 | $28 | $45 |
| BULKHEAD | | | | | | |
| | | 150 | 3.31 | 5.24 | $29 | $46 |
| | | 150 | 3.31 | 5.24 | $29 | |
| | | 104 | 5.66 | 8.97 | $85 | $137 |
| DECK | | | | | | |
| | | 150 | 1.10 | 1.75 | $10 | $16 |
| | | 150 | 1.10 | 1.75 | $10 | $16 |
| | | 104 | 1.89 | 2.99 | $28 | $45 |
| SUBTOTAL | | | | | $610 | $968 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 1-14-1-L | CB | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 1.20 | 1.91 | $11 | $17 |
| | | 124 | 1.75 | 2.77 | $23 | $36 |
| | | 124 | 1.75 | 2.77 | $23 | $36 |
| | BULKHEAD | | | | | |
| | | 150 | 2.64 | 4.18 | $23 | $37 |
| | | 124 | 2.87 | 4.55 | $37 | $59 |
| | | 124 | 2.87 | 4.55 | $37 | $59 |
| | DECK | | | | | |
| | | 150 | 1.20 | 1.91 | $11 | $17 |
| 1-33-l-L | SA | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.82 | 1.29 | $7 | $12 |
| | BULKHEAD | | | | | |
| | | 150 | 1.20 | 1.90 | $11 | $17 |
| | | 124 | 1.30 | 2.07 | $17 | $27 |
| | DECK | | | | | |
| | | 150 | 1.13 | 1.79 | $10 | $16 |
| | | LBE | 1.87 | 2.97 | $21 | $33 |
| | | LBE | 1.87 | 2.97 | $21 | $33 |
| 1-41-O-L | LR | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 1.60 | 2.54 | $14 | $23 |
| | | 126 | 2.35 | 3.73 | $31 | $49 |
| | | 126 | 1.77 | 2.80 | $23 | $36 |
| | BULKHEAD | | | | | |
| | | 150 | 4.62 | 7.32 | $41 | $65 |
| | | 126 | 5.09 | 8.07 | $66 | $105 |
| | | 126 | 5.09 | 8.07 | $66 | $105 |
| | DECK | | | | | |
| | | 150 | 1.40 | 2.21 | $12 | $20 |
| 1-5-O-L | PS | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.81 | 1.29 | | $11 |
| | | 124 | 1.18 | 1.87 | $ 7 | $24 |
| | | 124 | 1.18 | 1.87 | $15 | $24 |
| | BULKHEAD | | | | | |
| | | 150 | 1.59 | 2.52 | $14 | $22 |
| | | 124 | 1.73 | 2.75 | $23 | $36 |
| | | 124 | 2.31 | 3.66 | $30 | $48 |
| | DECK | | | | | |
| | | 150 | 0.81 | 1.29 | $7 | $11 |
| | | 150 | 1.08 | 1.72 | $10 | $15 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 1-5-2-A | SO | | | | | |
| | OVERHEAD | 150 | 0.43 | 0.68 | $4 | $6 |
| | | SMGWE | 0.77 | 1.22 | $10 | $ 5 |
| | BULKHEAD | 150 | 1.59 | 2.52 | $14 | $22 |
| | | SMGWE | 2.13 | 3.38 | $27 | $ 2 |
| | DECK | 150 | 0.43 | 0.68 | $4 | $6 |
| | | SMGWE | 0.77 | 1.22 | $10 | $ 5 |
| 1-70-1-Q | OF | | | | | |
| | OVERHEAD | 150 | 0.45 | 0.71 | $4 | $6 |
| | | 126 | 0.66 | 1.05 | $9 | $ 4 |
| | BULKHEAD | 150 | 1.19 | 1.88 | $11 | $17 |
| | | 150 | 1.58 | 2.51 | $14 | $ 2 |
| | | 124 | 1.72 | 2.73 | $22 | $ 5 |
| | DECK | 150 | 0.45 | 0.71 | $4 | $6 |
| | | 126 | 0.66 | 1.05 | $9 | $ 4 |
| 1-87-4-L | WS | | | | | |
| | OVERHEAD | 150 | 0.08 | 0.13 | $1 | |
| | | 124 | 0.09 | 0.14 | $1 | $ |
| | BULKHEAD | 150 | 0.21 | 0.34 | $2 | |
| | | 150 | 0.21 | 0.34 | $2 | |
| | | 126 | 0.18 | 0.28 | $2 | $ |
| | DECK | 150 | 0.08 | 0.13 | $1 | |
| | | 150 | 0.11 | 0.18 | $1 | $ |
| | | 126 | 0.09 | 0.15 | $1 | $ |
| SUBTOTAL | | | | | $777 | $1, -1 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 2-107-1-E | MS | | | | | |
| OVERHEAD | | 150 | 4.19 | 6.64 | $37 | $59 |
| | | 150 | 5.58 | 8.85 | $50 | $79 |
| | | 124 | 6.08 | 9.63 | $79 | $125 |
| BULKHEAD | | 150 | 11.28 | 17.88 | $100 | $159 |
| | | 124 | 12.28 | 19.46 | $160 | $253 |
| | | 124 | 12.28 | 19.46 | $160 | $253 |
| DECK | | 150 | 4.19 | 6.64 | $37 | $59 |
| | | 150 | 4.19 | 6.64 | $37 | $59 |
| 2-27-2-F | TK | | | | | |
| OVERHEAD | | 150 | 0.14 | 0.22 | $1 | $2 |
| | | 150 | 0.14 | 0.22 | $1 | $2 |
| | | 104 | 0.24 | 0.38 | $4 | $6 |
| BULKHEAD | | 150 | 0.42 | 0.67 | $4 | $6 |
| | | 150 | 0.42 | 0.67 | $4 | $6 |
| | | 104 | 0.72 | 1.15 | $11 | $17 |
| DECK | | 150 | 0.13 | 0.21 | $1 | $2 |
| | | 150 | 0.13 | 0.21 | $1 | $2 |
| | | 104 | 0.23 | 0.36 | $3 | $5 |
| 3-11-O-Q | TK | | | | | |
| OVERHEAD | | 150 | 0.38 | 0.61 | $3 | $5 |
| | | 150 | 0.38 | 0.61 | $3 | $5 |
| | | 104 | 0.66 | 1.04 | $10 | $16 |
| BULKHEAD | | 150 | 1.59 | 2.52 | $14 | $22 |
| | | 150 | 1.59 | 2.52 | $14 | $22 |
| | | 104 | 2.72 | 4.32 | $41 | $65 |
| DECK | | 150 | 0.35 | 0.55 | $3 | $5 |
| | | 150 | 0.35 | 0.55 | $3 | $5 |
| | | 104 | 0.60 | 0.95 | $9 | $14 |

| COMPARTMENT NUMBER | COMPT TYPE | PAINT TYPE | PAINT GALS W/O REWORK | PAINT GALS WITH REWORK | PAINT COST WITHOUT REWORK | PAINT COST WITH REWORK |
|---|---|---|---|---|---|---|
| 340-O-E | MS | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 5.02 | 7.96 | $45 | $71 |
| | | 150 | 6.70 | 10.62 | $60 | $9 |
| | | 124 | 7.29 | 11.56 | $95 | $15 |
| | BULKHEAD | | | | | |
| | | 150 | 17.45 | 27.66 | $155 | $24 |
| | | 124 | 18.99 | 30.12 | $247 | $39. |
| | | 124 | 18.99 | 30.12 | $247 | $392 |
| | DECK | | | | | |
| | | 150 | 5.02 | 7.96 | $45 | $7 |
| | | 150 | 5.02 | 7.96 | $45 | $71 |
| 2-104-3-F | TK | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 0.17 | 0.28 | **$2** | $4 |
| | | 150 | 0.17 | 0.28 | **$2** | $2 |
| | | 104 | 0.30 | 0.47 | **$4** | $ |
| | BULKHEAD | | | | | |
| | | 150 | 0.55 | 0.87 | **$5** | $8 |
| | | 150 | 0.55 | 0.87 | **$5** | |
| | | 104 | 0.94 | 1.49 | **$14** | $ 2 |
| | DECK | | | | | |
| | | 150 | 0.12 | 0.19 | **$1** | $7 |
| | | 150 | 0.12 | 0.19 | **$1** | $ |
| | | 104 | 0.20 | 0.32 | **$3** | $5 |
| 3-68-O-E | MS | | | | | |
| | OVERHEAD | | | | | |
| | | 150 | 4.81 | 7.63 | $43 | |
| | | 150 | 6.42 | 10.18 | $57 | $ 6 |
| | | 124 | 6.99 | 11.08 | $91 | $14 |
| | BULKHEAD | | | | | |
| | | 150 | 14.45 | 22.91 | $129 | $204 |
| | | 124 | 15.73 | 24.94 | $204 | $324 |
| | | 124 | 15.73 | 24.94 | $204 | $32 |
| | DECK | | | | | |
| | | 150 | 4.88 | 7.74 | $43 | $69 |
| | | 150 | 4.88 | 7.74 | $43 | $6 |
| SUBTOTAL . . . . . | | | | | $2,581 | $4,092 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
SUPPLEMENTAL PAINT SYSTEMS ESTIMATE



| AREA DESCRIPTION | PAINT TYPE | GALS EST W/O REWORK | GALS EST W REWORK | PAINT COST EST W/O REWORK | PAINT COST EST WITH REWORK |
|---|---|---|---|---|---|
| FIRE ZONE BULKHEADS | 1088 | 11 | 17 | $316 | $500 |
| FURNITURE MISC | 124 | 18 | 28 | $230 | $365 |
| INTERIOR NON-SKID | 1139R | 800 | 1,268 | $25,600 | $40,588 |
| MACHINERY AND EQUIPMENT | 111 | 25 | 40 | $278 | $441 |
| SUPPLEMENTAL PAINT SYSTEMS TOTAL | | | | $26.424 | $41,894 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
PAINT TYPE SUMMARY



12-10-1988

| PAINT TYPE | GALLONS EST W/O REWORK | GALLONS EST WITH REWORK | COST EST W/0 REWORK | COST EST WITH REWORK |
|---|---|---|---|---|
| 104 | 26 | 41 | $390 | $619 |
| 1088 | 11 | 17 | $316 | $500 |
| 111 | 27 | 43 | $295 | $468 |
| 1139R | 1,772 | 2,809 | $56,698 | $89,892 |
| 124 | 197 | 312 | $2,560 | $4,059 |
| 126 | 17 | 26 | $217 | $344 |
| 150 | 377 | 598 | $3,356 | $5,320 |
| HGE | 413 | 655 | $5,906 | $9,363 |
| LBE | 8 | 13 | $92 | $146 |
| SMGWE | 6 | 10 | $77 | $122 |
| PAINT SUB TOTAL . . . . . | | | $69,907 | $110,835 |

SP-3 BID STAGE ESTIMATOR
RSV PAINTING ESTIMATES
TOTAL COST SUMMARY



| | COST EST W/O REWORK | COST EST WITH REWORK |
|---|---|---|
| GENERAL LABOR COST . . . . . | $666,566 | $1.056,809 |
| SUPPLEMENTAL LABOR COST . . . . . | $87,050 | $168,450 |
| SUPPLEMENTAL MATERIAL COST . . . . | $9,812 | $15,557 |
| PAINT COST . . . . . | $69,907 | $110,835 |
| TOTAL COST . . . . . | $833,336 | $1,351,650 |

# APPENDIX F

# USERS MANUAL

# THE BID STAGE ESTIMATING

# USERS MANUAL

DECEMBER 1988

U.S. DEPARTMENT OF TRANSPORTATION

MARITIME ADMINISTRATION

PREPARED BY:

INSIGHT INDUSTRIES, INC.
PLATTEVILLE, WISCONSIN 53818

FOR:

PETERSON BUILDERS, INC.
STURGEON BAY, WI 54235

IN COOPERATION WITH:

NASSCO
NATIONAL STEEL AND SHIPBUILDING COMPANY
A MORRISON-KNUDSEN COMPANY
SAN DIEGO, CALIFORNIA

TABLE OF CONTENTS

## 1.0 INTRODUCTION

The Bid Stage Estimating program is an easy program to learn. The user can start utilizing it immediately, without having to use this manual. The menus are self explanatory, but for the users convenience, copies of the menus and sample resultant screens are reviewed in this manual. The user will find sample RSV (Research Vessel) bid and comparable ship files on the data disk. The sample data, including paint costs, paint coverages, hourly rates, etc. should be replaced with actual yard data.

## 2.0 INSTALLATION

The Bid Estimating Program requires an IBM PC or compatible with a hard disk. 640K of RAM is required to run the proqram. Before installing the program, it is advised that the-user make backup copies of the disks. To install the program, place the program disk in drive A. Make sure that the PC is currently accessing the root on the C drive. Continue by typing "A:INSTALL". This command will invoke the batch file that will load the Bid Stage Estimating files onto the hard disk. The batch file INSTALL will prompt the user to insert the data disk when appropriate. The batch file will create two sub-directories on the C drive off of the root directory. The two sub-directories will be called PNTEST and PNTDATA. All of the Bid Stage Estimating program files will reside in the PNTEST sub-directory and all of the data files will reside in the PNTDATA sub-directory. If the files do not reside in these sub-directories the user will receive "path" errors. To run the program, the user must type "PAINT" in the PNTEST sub-directory.

## 3.0 SPECIAL FEATURES

When using the Bid Estimating Program, PLEASE MAKE SURE THAT THE "CAPS LOCK" KEY IS ACTIVATED. If the Caps Lock key has not been turned on the user will experience problems in activating several options in the program menus.

THE USER IS WARNED NEVER TO ERASE ALL THE BID SHIP FILES, THE COMPARABLE SHIP FILES, THE COMPARTMENT TYPES OR THE PAINT TYPES . If all the data is erased in any one of these data types, the program may fail.

The program is limited to the number of data records that can

be entered and the amounts in the respective fields. The following is a list of these limits.

| DATA TYPE | NUMBER ALLOWED |
|---|---|
| BID SHIP FILES | 100 |
| COMPARABLE SHIP FILES | 100 |
| PAINT TYPES | 200 |
| COMPARTMENT TYPES | 100 |
| COMPARTMENTS | 500 |
| SUPPLEMENTAL LABOR ITEMS | 50 |
| SUPPLEMENTAL MATERIAL ITEMS | 50 |
| SUPPLEMENTAL PAINT SYSTEMS | 50 |
| PAINT COATS/COMPARTMENT | 5 |

| DATA FIELD | QUANTITY ALLOWED |
|---|---|
| # SQFT/GAL @ lMIL DFT | 999 |
| $/GALLON | $99 |
| BS COMPT SQFT(OVERHEAD,BULKHEAD,DECK) | 999,999ea |
| BS PAINT MILS(OVERHEAD,BULKHEAD,DECK) | 99ea |
| BS SUPPLEMENTAL PAINT SYSTEM SQFT | 99,999 |
| BS SUPPLEMENTAL PAINT SYSTEM MILS | |
| BS AVERAGE HOURLY CHARGE OUT RATE | $99 |
| CS MINS/SQFT W & W/O REWORK | 99ea |
| CS GENERAL LABOR HOURS W & W/O REWORK | 9,999,999ea |
| CS AVERAGE HOURLY CHARGE OUT RATE | $99 |
| CS SUPPLEMENTAL LABOR HOURS W & W/O REWORK | 99,999ea |
| CS SUPPLEMENTAL MATERIAL COST | $999,999 |

## 4.0 DATA STRUCTURE

In general the Bid Stage Estimating program is divided into four major modules: Paint Data, Bid Ship Data, Comparable Ship Data and Compartment Type Data. Please see Figure 4-1. The following paragraphs will explain important features to remember when entering data.

### 4.1 PAINT DATA

The Paint Data module maintains all of the master paint data, please see Figure 4-2. The user should load the most recent paint data that is germane to the present operation of the company. New paint types may be added as they become available. The sqft/gal rating refers to the theoretical

coverage/gallon of the paint provided by the vendor at 1 mil DFT . Please see Figure 4-3 for an example input screen.

## 4.2 BID SHIP DATA

The Bid Ship Data consists of information that has been entered about a contract that the firm is presently bidding. The Bid Ship Data is broken down into four modules: compartment data, paint systems by compartment type, supplemental paint systems, and the average hourly charge out rate. Please see Figure 4-4. Data must be loaded for each module.

### 4.2.1 COMPARTMENT DATA

The term compartment should be interchangeable with the word area. In other words, compartment could also be a block, a unit, etc. Compartment refers to a space. Consequently, the term zone refers to a grouping of compartments. The compartment type must also be identified. Please note, when entering hull sqft data, it should be entered under the "BLKHDS" heading. Please see Figure 4-5 for an example compartment data entry screen.

### 4.2.2 PAINT SYSTEMS BY COMPARTMENT TYPE

For each compartment type associated with the chosen comparable ship, a paint system must be developed. The user must enter paint types and anticipated dry film thicknesses. The system will allow up to 5 different paint types to be identified for each compartment type. Coatings that are applied at different time periods but make use of the same paint may be grouped together in order to allow for more than five coatings. If a wrong paint type is entered, the program will provide a list of the valid paint types. Please see Figure 4-6 for a sample screen.

### 4.2.3 SUPPLEMENTAL PAINT SYSTEMS

The program allows for the entry of supplemental paint systems. This portion of the program should be used to account for paint that is used for special circumstances, such as fire retardant paint, anti-sweat paint, etc. When entering the data, the total sqft that is expected to be covered should be totaled and entered as one Figure. Please see Figure 4-7.

### 4.2.4 AVERAGE HOURLY CHARGE OUT RATE

This rate refers to the hourly charge that should be accessed in order to reflect what it would cost to have the work performed by sub-contractors. In other words, the rate should be fully burdened so that proper "make vs buy" or "in-house vs sub-contract" decisions can be made.

## 4.3 COMPARABLE SHIP DATA

The Comparable Ship Data refers to the data that has been entered from historical databases. The Comparable Ship Data consists of four modules: mins/sqft data, general labor data, supplemental labor data, and supplemental material data. Please see Figure 4-8. Data must be loaded for each module.

### 4.3.1 MINS/SQFT DATA

The mins/sqft data must be entered by compartment type, with and without rework. The mins/sqft factors should account for labor that can be directly attributed to a particular compartment\block/unit type. The amount of rework may be derived directly from hours collected without and with rework, or a rework ratio may be used that the company has established. Please see Figure 4-9.

### 4.3.2 GENERAL LABOR DATA

The General Labor Data refers to the total hours spent on the contract that can be attributed to the mins/sqft data.

### 4.3.3 SUPPLEMENTAL LABOR DATA

The Supplemental Labor Data refers to the hours spent performing operations that cannot be/or is economically not feasible to directly attribute to a particular compartment type. An example of an operation of this nature might be tough-up throughout, sandblasting small parts, sandblasting assemblies, etc. Each supplemental data item must be entered without and with rework. Please see Figure 4-10.

### 4.3.4 SUPPLEMENTAL MATERIAL DATA

The Supplemental Material Data refers to the materials other than paint that are used by the Paint Department; for example: blast grit, brushes, solvent, etc. The user may choose not to identify any supplemental material. This is entirely up to the user and the circumstances of his/her

yard. If the user chooses to identify supplemental material, total dollar figures with rework should be used. Please see Figure 4-11.

## 4.4 COMPARTMENT TYPE DATA

The Compartment Type data should include a list of valid compartment types and their respective descriptions. Please see Figure 4-12. The compartment types may be the list suggested in the Bid Stage Estimating report or the compartment types unique to the user's yard. Before choosing compartment types, the user should carefully decide which breakdown best suits his/her yard estimating practices. Please see Figure 4-13 for an example screen.

# 5.0 PROGRAM MENUS/INITIALIZATION MENU

The program is a menu driven system. There are a total of 13 menus. Please see Figure 5-1. Each menu will have a total of 9 options. Options 1 through 7 will describe a particular function that the user may invoke. Option 8 will always return the user to the previous menu. Option 9 will always provide help. This format of options is consistent throughout the program.

As an option is chosen, the user need not press the ENTER key. The program will automatically advance as soon as a number is chosen. The remainder of this section of the manual will present actual screens of the menus. Menus that are self explanatory will not be discussed.

The very first menu that the user will see is the master menu. From this menu the user will begin his bid development process. This menu is also the only place where the user can exit the program. Please see Figure 5-2.

## 5.1 MASTER PAINT TYPE MENU

(Please see Figure 5-3)

## 5.2 MASTER COMPARTMENT TYPE MENU

(Please see Figure 5-4)

## 5.3 FILE CREATION MENU

(Please see Figure 5-5)

5.3.1 BID SHIP FILE MAINTENANCE MENU

(Please see Figure 5-6)

5.3.1.1 COMPARTMENT FILE MAINTENANCE MENU

(Please see Figure 5-7)

5.3.1.2 PAINT SYSTEMS FILE MAINTENANCE MENU

(Please see Figure 5-8 )

5.3 .1.3 SUPPLEMENTAL PAINT SYSTEM FILE MAINTENANCE MENU

(Please see Figure 5-9)

5.3.2 COMPARABLE SHIP FILE MAINTENANCE MENU

(Please see Figure 5-10)

5.3.2.1 MINS/SQFT FILE MAINTENANCE MENU

(Please see Figure 5-11)

5.3.2.2 SUPPLEMENTAL LABOR FILE MAINTENANCE MENU

(Please see Figure 5-12)

5 .3.2.3 SUPPLEMENTAL MATERIAL FILE MAINTENANCE MENU

(Please see Figure 5-13 )

5.4 DISK MAINTENANCE MENU

The Disk Maintenance menu allows the user to switch comparable ship files for each bid ship. This is probably one of the most important features of this program. Being able to switch comparable ship files, means that the user can make use of his historical data with very little effort. Switching the comparable ship file name will load a completely different set of mins/sqft, supplemental labor items, etc. Please see Figure 5-14.

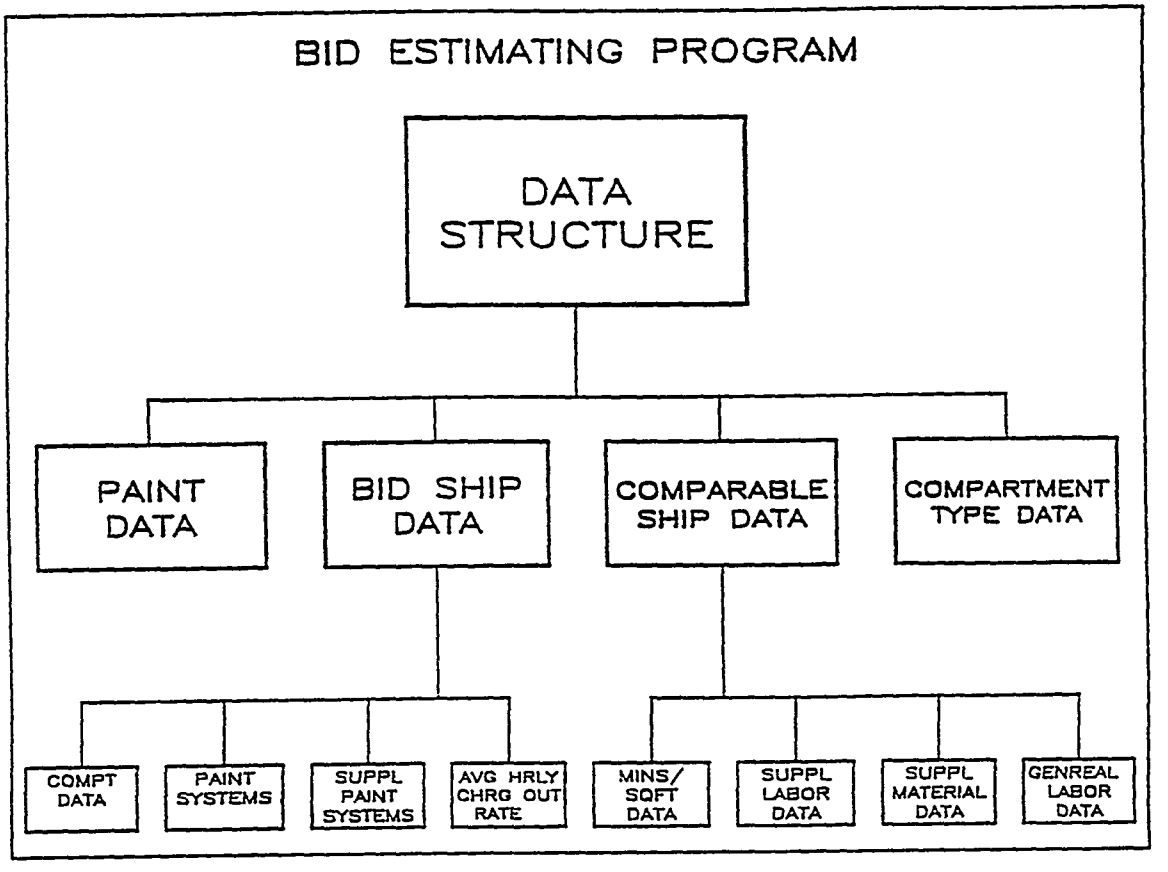
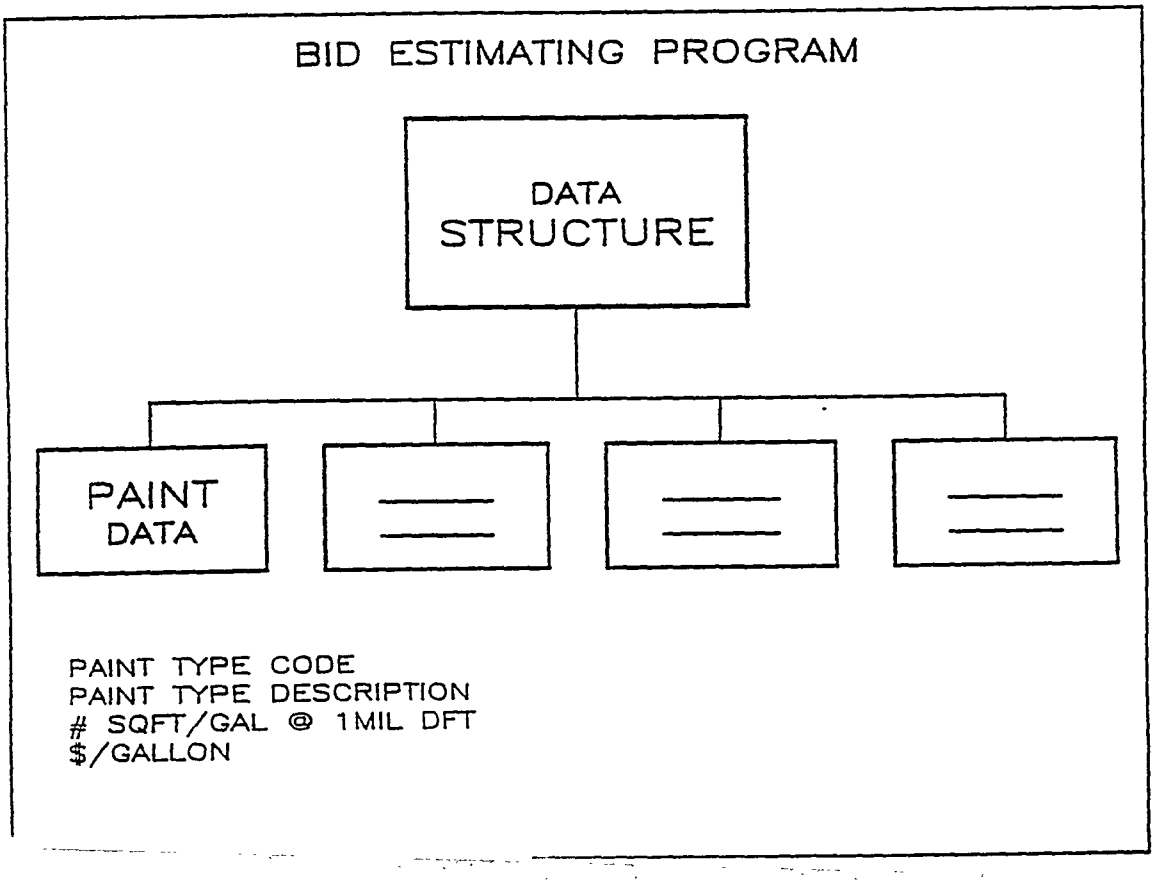
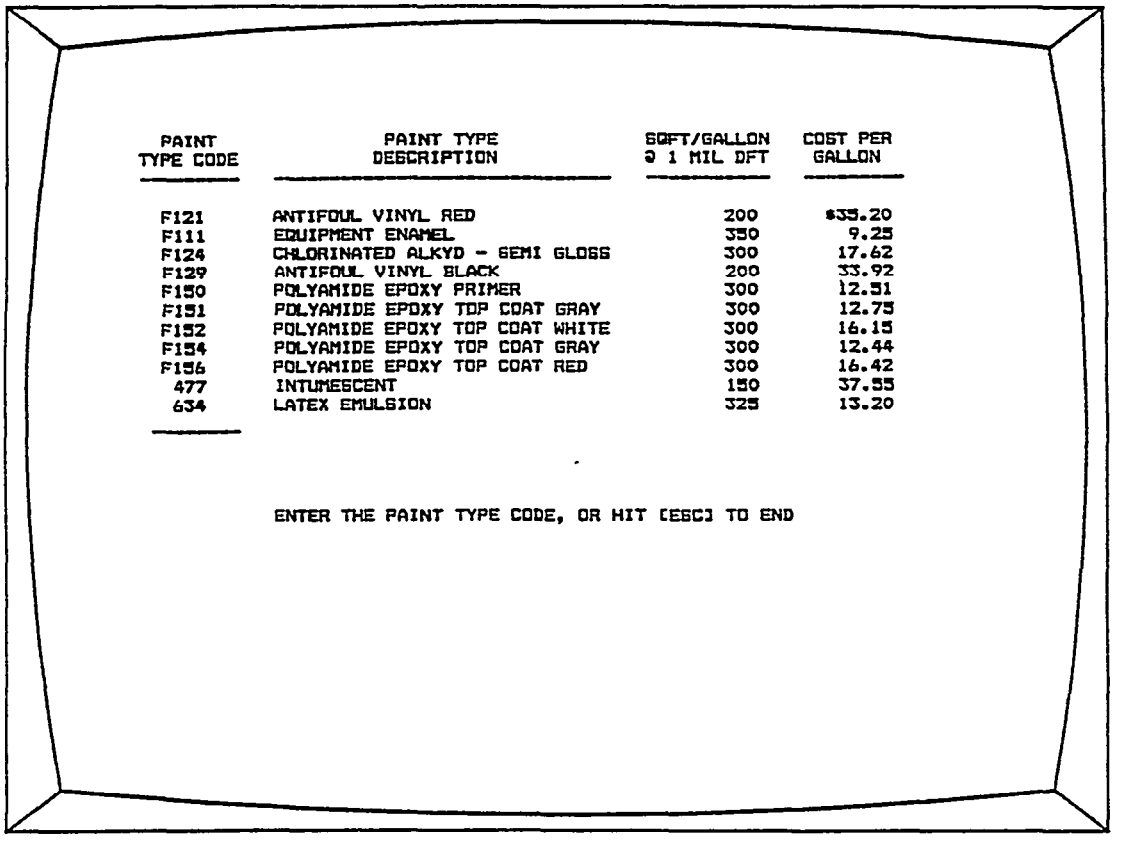

BID ESTIMATING PROGRAM
DATA STRUCTURE
PAINT DATA
BID SHIP DATA
COMPARABLE SHIP DATA
COMPARTMENT TYPE DATA
COMPT DATA
PAINT SYSTEMS
SUPPL PAINT SYSTEMS
AVG HRLY CHRG OUT RATE
MINS/ SQFT DATA
SUPPL LABOR DATA
SUPPL MATERIAL DATA
GENREAL LABOR DATA

Figure 4-1.


BID ESTIMATING PROGRAM
DATA STRUCTURE
PAINT DATA
PAINT TYPE CODE
PAINT TYPE DESCRIPTION
# SQFT/GAL @ 1MIL DFT
$/GALLON



| PAINT TYPE CODE | PAINT TYPE DESCRIPTION | SQFT/GALLON @ 1 MIL DFT | COST PER GALLON |
|---|---|---|---|
| F121 | ANTIFOUL VINYL RED | 200 | $35.20 |
| F111 | EQUIPMENT ENAMEL | 350 | 9.25 |
| F124 | CHLORINATED ALKYD - SEMI GLOSS | 300 | 17.62 |
| F129 | ANTIFOUL VINYL BLACK | 200 | 33.92 |
| F150 | POLYAMIDE EPOXY PRIMER | 300 | 12.51 |
| F151 | POLYAMIDE EPOXY TOP COAT GRAY | 300 | 12.75 |
| F152 | POLYAMIDE EPOXY TOP COAT WHITE | 300 | 16.15 |
| F154 | POLYAMIDE EPOXY TOP COAT GRAY | 300 | 12.44 |
| F156 | POLYAMIDE EPOXY TOP COAT RED | 300 | 16.42 |
| 477 | INTUMESCENT | 150 | 37.55 |
| 634 | LATEX EMULSION | 325 | 13.20 |

ENTER THE PAINT TYPE CODE, OR HIT [ESC] TO END

Figure 4-3.

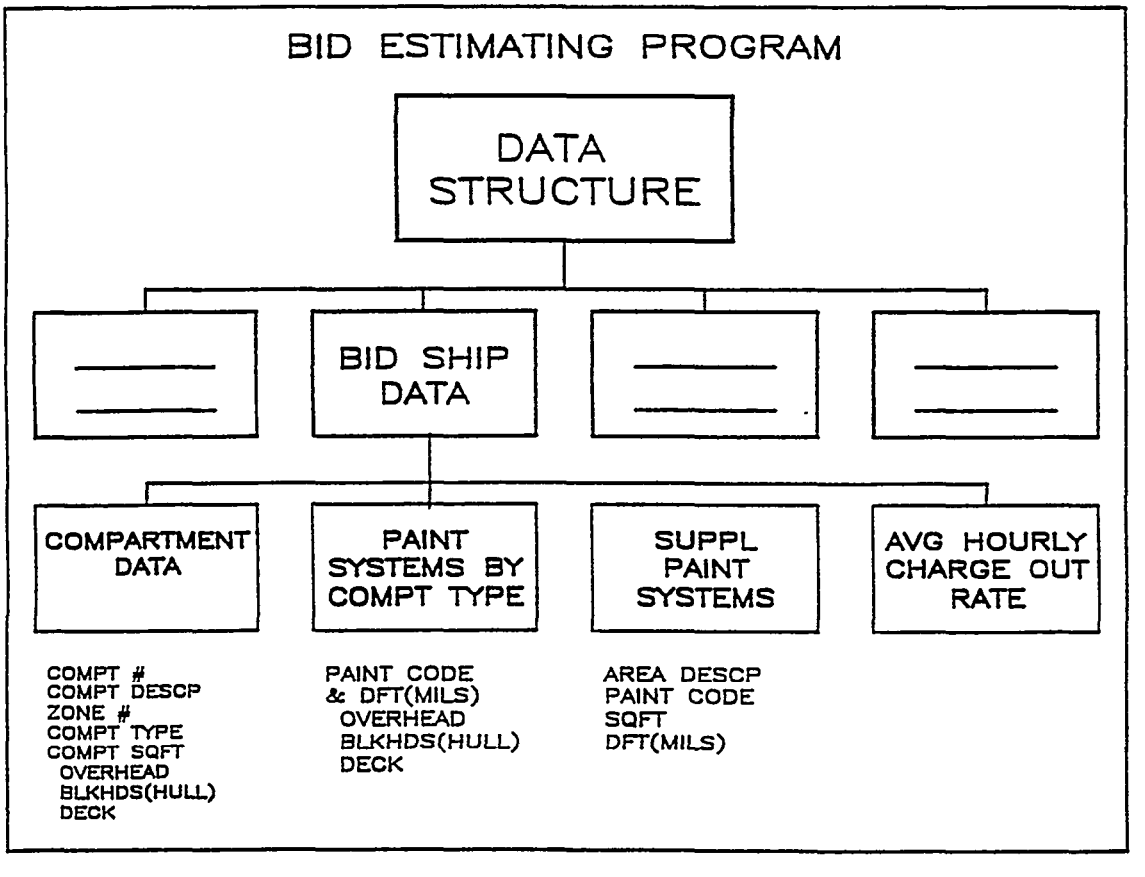



Figure 4-4.

| COMPARTMENT NUMBER | COMPARTMENT DESCRIPTION | ZONE NUMBER | COMPARTMENT TYPE | SQUARE FEET |
|---|---|---|---|---|
| 3-63-0-E | MAIN MACHINERY ROOM | 002 | MS | 1500<br>3400<br>1500 |
| 3-41-0-E | AUXILIARY MACHINERY ROOM | 003 | MS | 1200<br>3100<br>1200 |
| 01-41-0-L | PASSAGE | 006 | PS | 600<br>1300<br>600 |
| 01-63-01-L | CO STATEROOM | 006 | SA | 225 |

ENTER THE SQUARE FEET OF THE BULKHEAD

Figure 4-5.

COMPARTMENT TYPE: MS
DESCRIPTION: MACHINERY SPACE

| OVERHEAD PAINT SYSTEM | | BULKHEAD(HULL) PAINT SYSTEM | | DECK PAINT SYSTEM | |
|---|---|---|---|---|---|
| PAINT TYPE | DRY MIL FILM THICK | PAINT TYPE | DRY MIL FILM THICK | PAINT TYPE | DRY MIL FILM THICK |
| F150 | 1.5 | F150 | 3.0 | F150 | 3.0 |
| 634 | 1.5 | 634 | 1.5 | 477 | 5.0 |
| F124 | 1.5 | F124 | 1.5 | 477 | 5.0 |

ENTER THE PAINT TYPE OR PRESS [ESC] TO END

SUPPLEMENTAL PAINT SYSTEMS

| PAINT TYPE | AREA DESCRIPTION | SQUARE FEET | DRY MIL FILM THICK |
|---|---|---|---|
| 477 | 3-63-0-E BULKHEAD 63 ONLY | 400 | 10.0 |
| F150 | 1-56-0-Q BULKHEAD 63 ONLY | 300 | 1.5 |
| F124 | 1-56-0-Q BULKHEAD 63 ONLY | 300 | 3.0 |
| 477 | 1-59-3-Q FIRE ZONE BULKHEADS | 160 | 10.0 |

ENTER THE PAINT TYPE OR HIT [ESC] TO END

Figure 4-7.

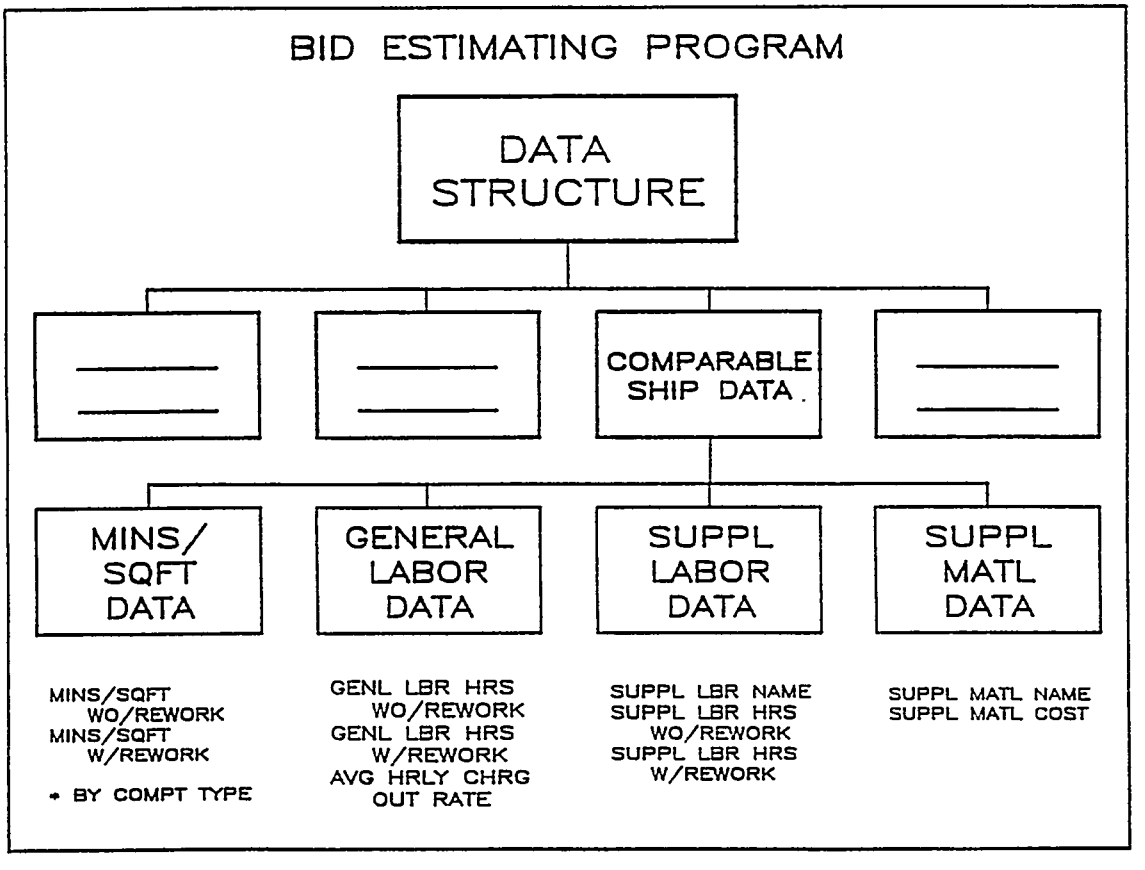



Figure 4-8.

| COMPARTMENT TYPE | COMPARTMENT TYPE DESCRIPTION | MINS/SQFT WITHOUT REWORK | MINS/SQFT WITH REWORK |
|---|---|---|---|
| CB | CREW BERTHING | 12.30 | 21.10 |
| CF | CHILL/FREEZE | 4.50 | 4.70 |
| FR | FAN ROOM | 20.50 | 26.10 |
| GY | GALLEY | 10.20 | 13.90 |
| IU | INTAKE/UPTAKE | 10.40 | 13.70 |
| LK | LOCKER | 14.20 | 18.70 |
| LR | LOUNGE AND RECREATION | 11.70 | 14.40 |
| MS | MACHINERY SPACE | 47.90 | 69.40 |
| OF | OFFICE | 15.20 | 19.70 |
| PS | PASSAGE | 18.20 | 23.10 |
| SA | STATEROOM | 13.20 | |

ENTER THE MINS/SQFT FIGURE WITH REWORK

Figure 4-9.

| SUPPLEMENTAL LABOR NAME | SUPPLEMENTAL LABOR HOURS WITHOUT REWORK | SUPPLEMENTAL LABOR HOURS WITH REWORK |
|---|---|---|
| SHOP BLAST PAINT ASSEMBLIES | 3950 | 4210 |
| SMALL PARTS | 5478 | 5685 |

ENTER THE SUPPLEMENTAL LABOR NAME, OR HIT [ESC] TO END

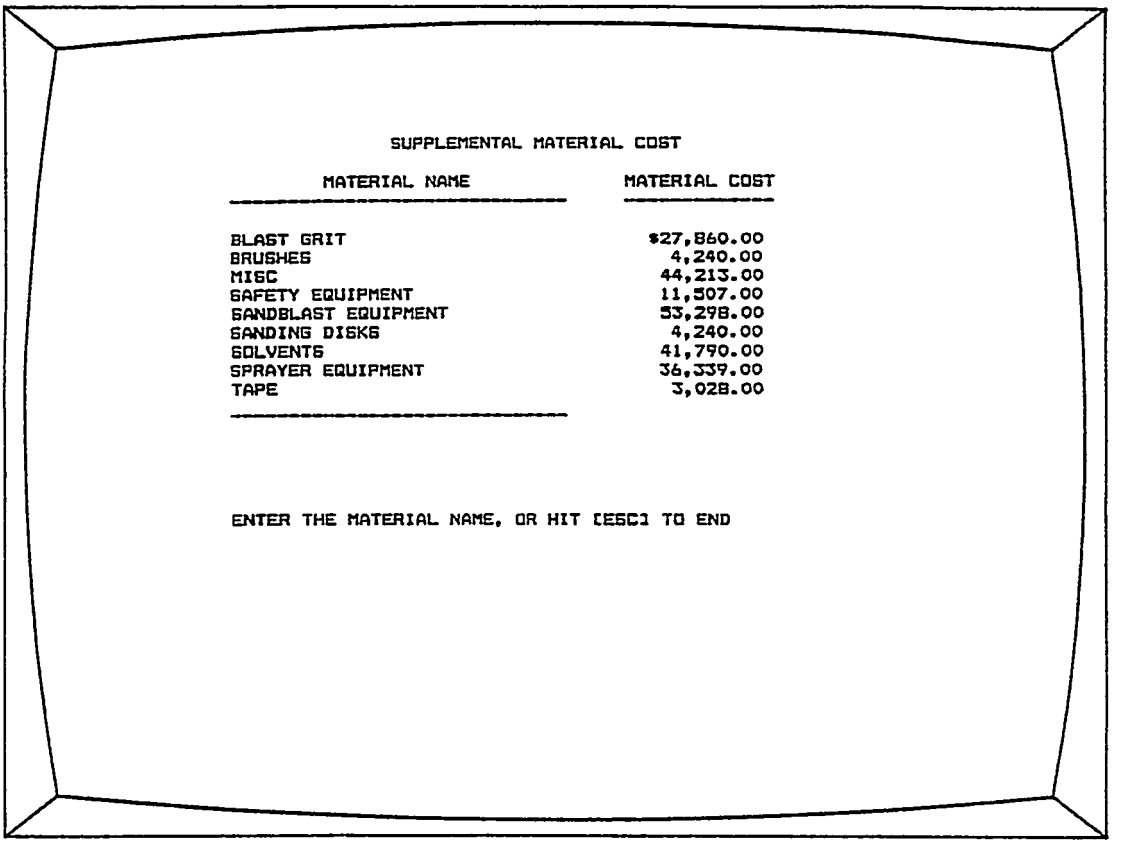



Figure 4-11.

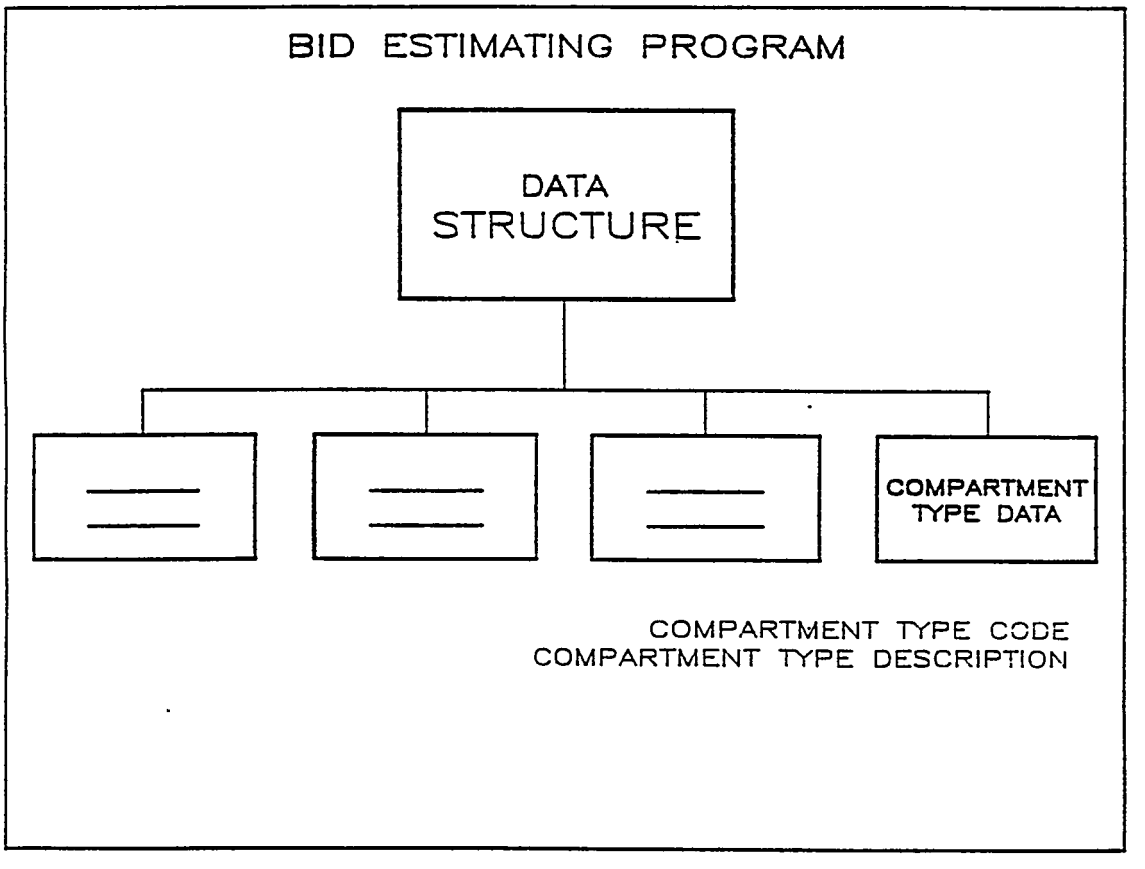



Figure 4-12.

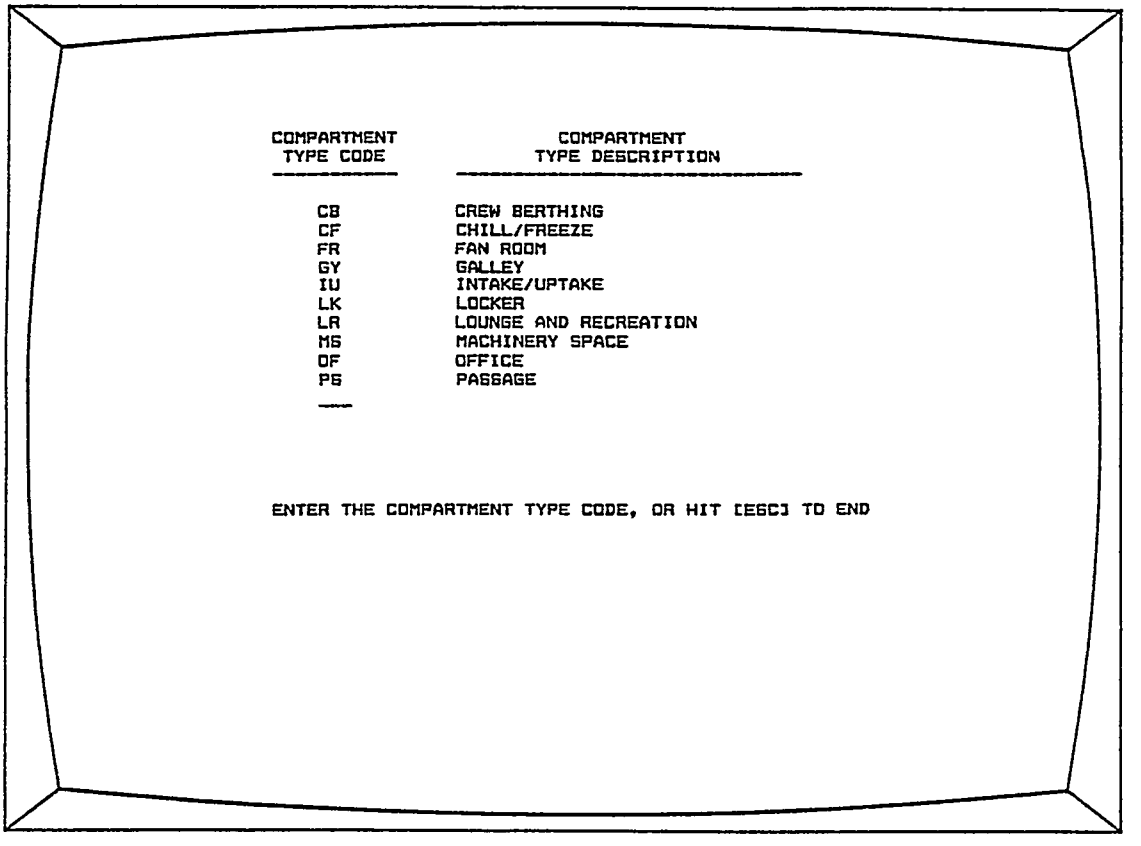



Figure 4-13.

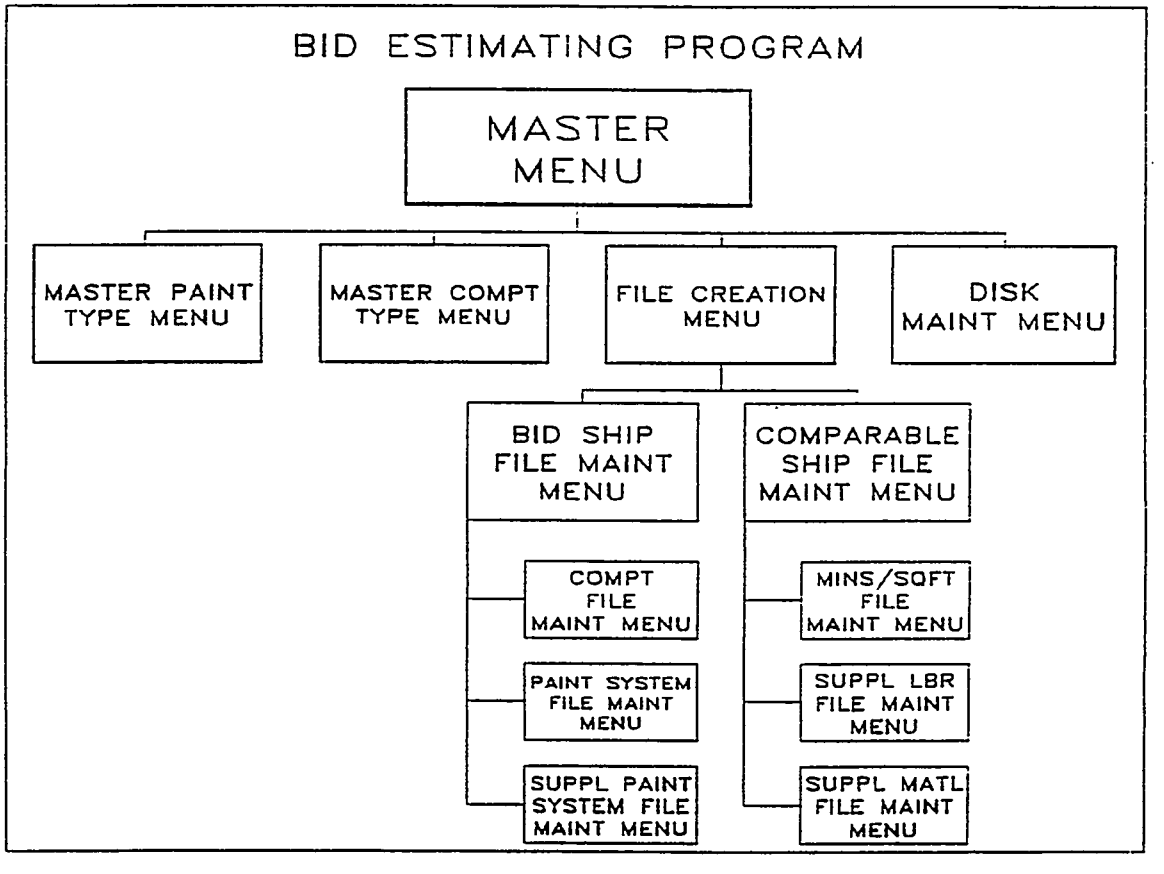



Figure 5-1

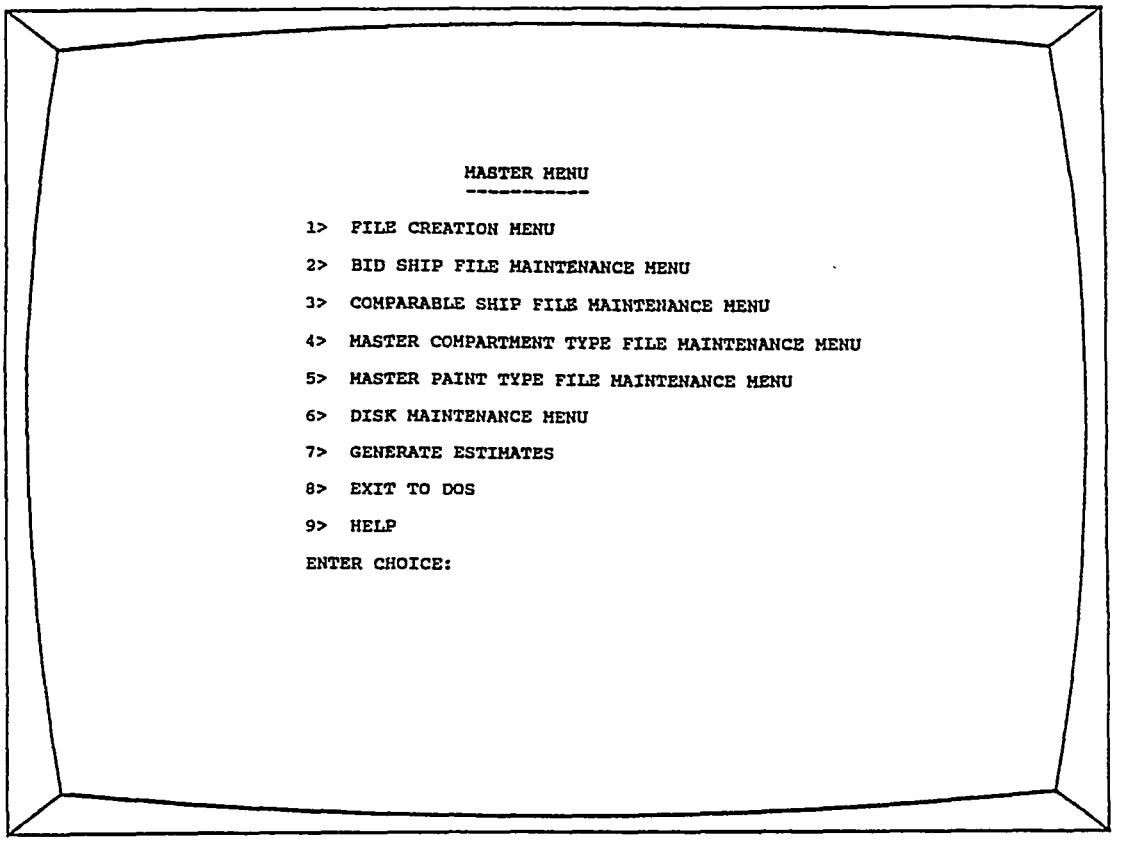



Figure 5-2.

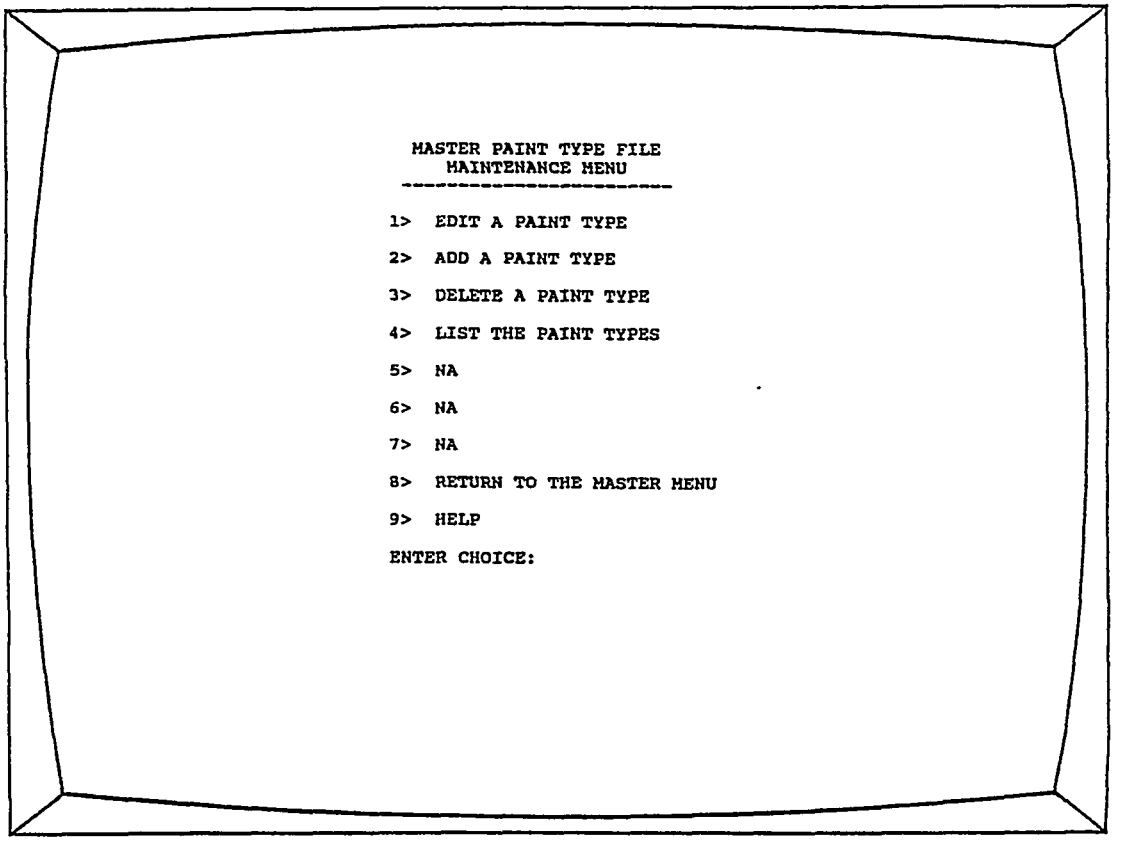



Figure 5-3.

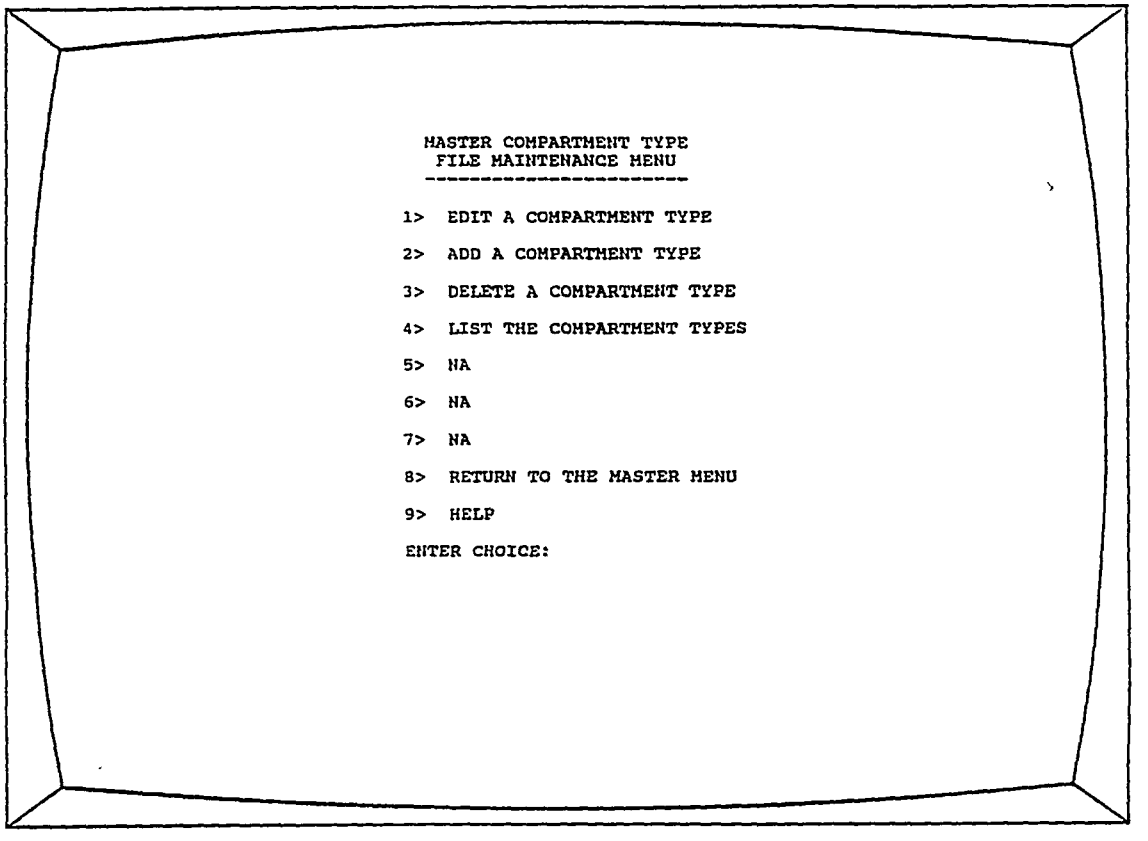
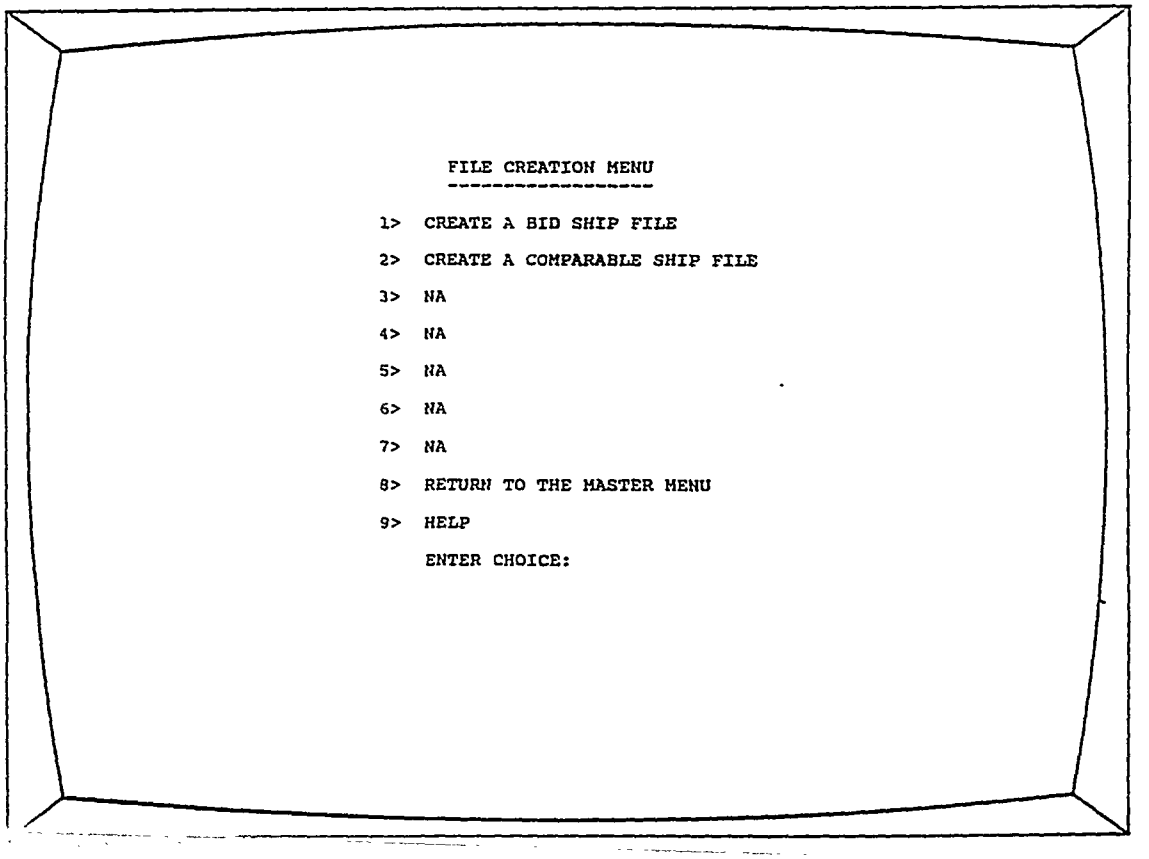

MASTER COMPARTMENT TYPE
FILE MAINTENANCE MENU
1> EDIT A COMPARTMENT TYPE
2> ADD A COMPARTMENT TYPE
3> DELETE A COMPARTMENT TYPE
4> LIST THE COMPARTMENT TYPES
5> NA
6> NA
7> NA
8> RETURN TO THE MASTER MENU
9> HELP
ENTER CHOICE:

Figure 5-4.


FILE CREATION MENU
1> CREATE A BID SHIP FILE
2> CREATE A COMPARABLE SHIP FILE
3> NA
4> NA
5> NA
6> NA
7> NA
8> RETURN TO THE MASTER MENU
9> HELP
ENTER CHOICE:

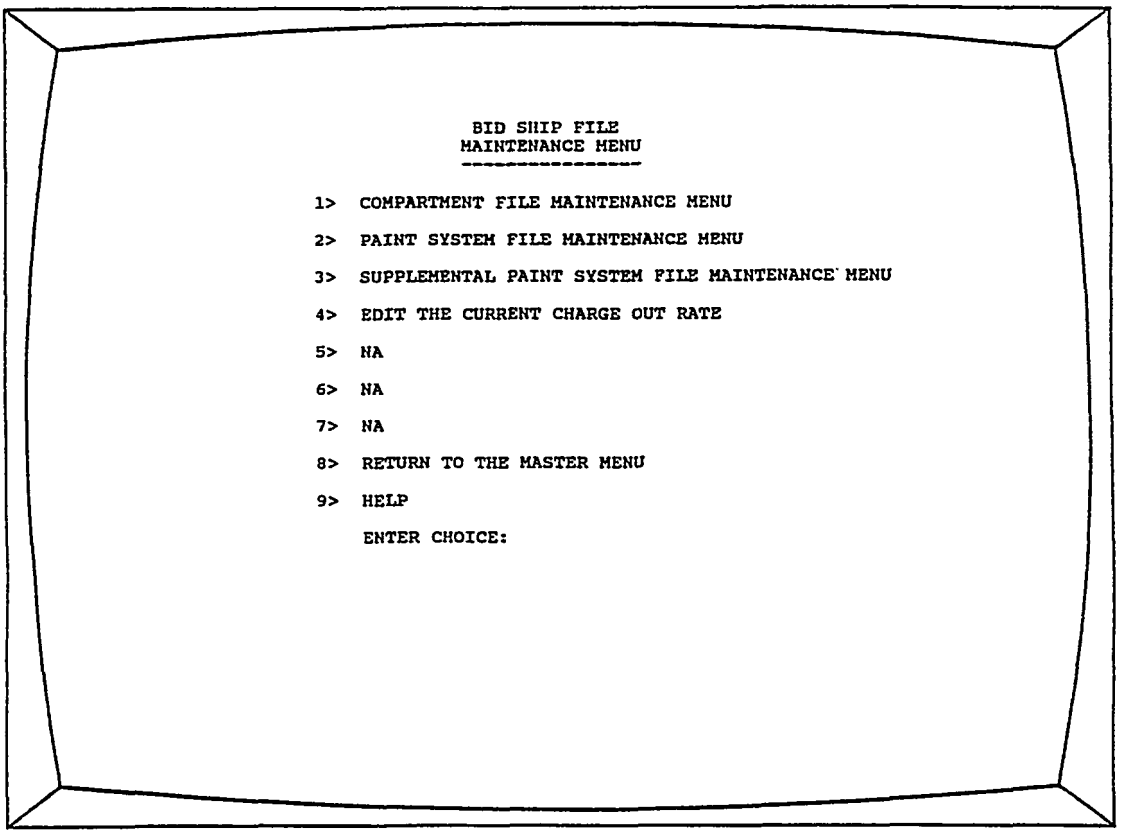



Figure 5-6.

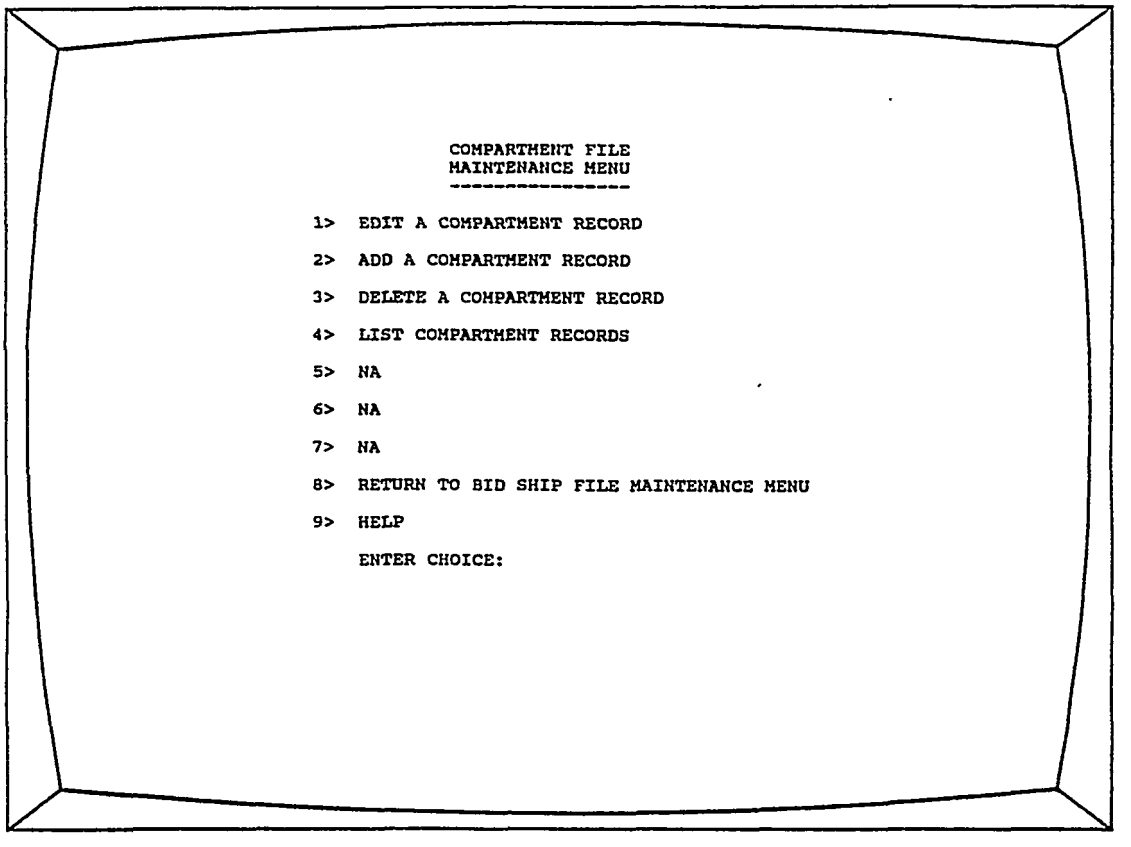



Figure 5-7.

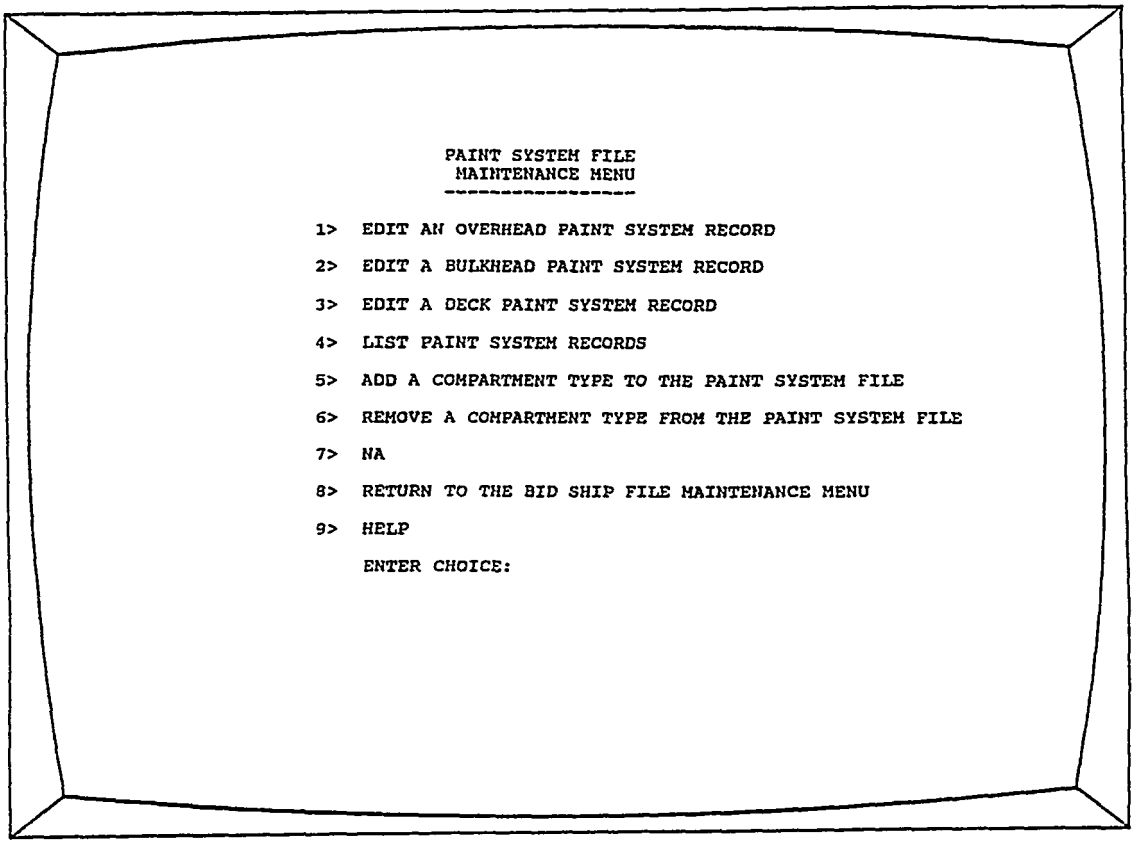
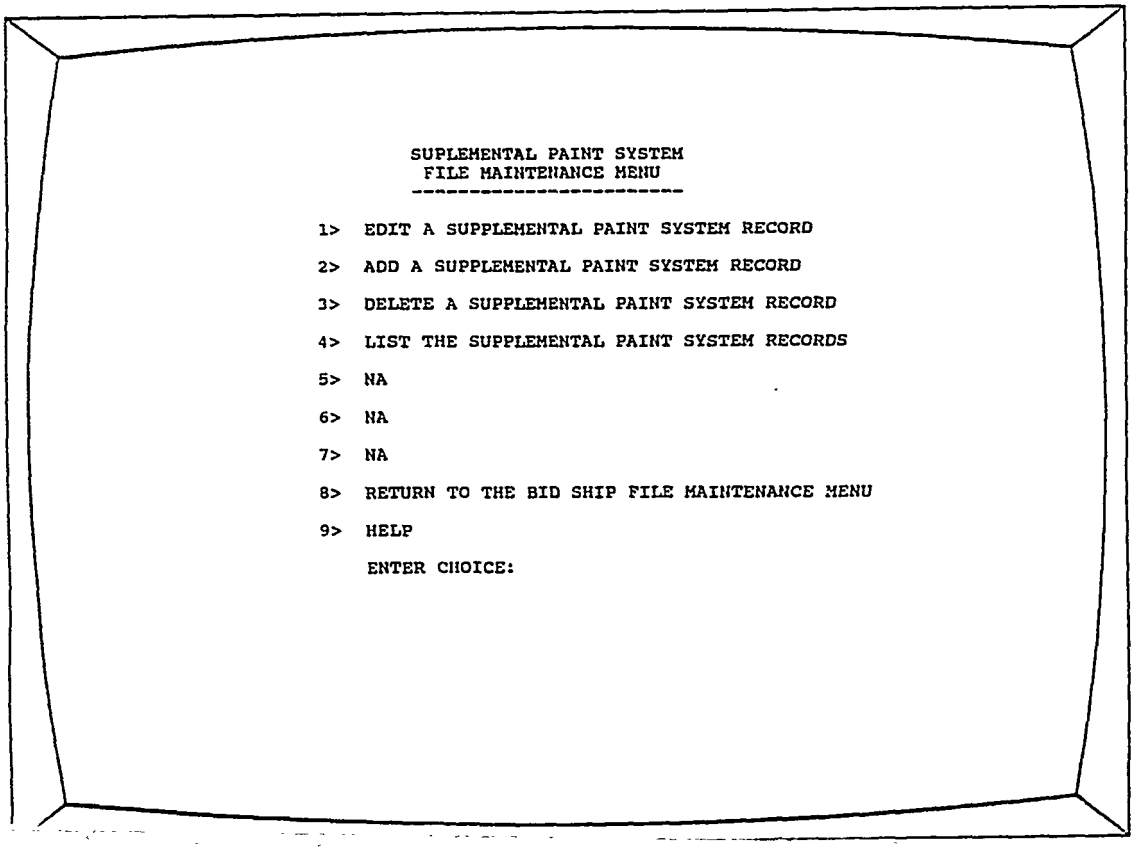

PAINT SYSTEM FILE
MAINTENANCE MENU
1> EDIT AN OVERHEAD PAINT SYSTEM RECORD
2> EDIT A BULKHEAD PAINT SYSTEM RECORD
3> EDIT A DECK PAINT SYSTEM RECORD
4> LIST PAINT SYSTEM RECORDS
5> ADD A COMPARTMENT TYPE TO THE PAINT SYSTEM FILE
6> REMOVE A COMPARTMENT TYPE FROM THE PAINT SYSTEM FILE
7> NA
8> RETURN TO THE BID SHIP FILE MAINTENANCE MENU
9> HELP
ENTER CHOICE:

Figure 5-8.


SUPLEMENTAL PAINT SYSTEM
FILE MAINTENANCE MENU
1> EDIT A SUPPLEMENTAL PAINT SYSTEM RECORD
2> ADD A SUPPLEMENTAL PAINT SYSTEM RECORD
3> DELETE A SUPPLEMENTAL PAINT SYSTEM RECORD
4> LIST THE SUPPLEMENTAL PAINT SYSTEM RECORDS
5> NA
6> NA
7> NA
8> RETURN TO THE BID SHIP FILE MAINTENANCE MENU
9> HELP
ENTER CHOICE:

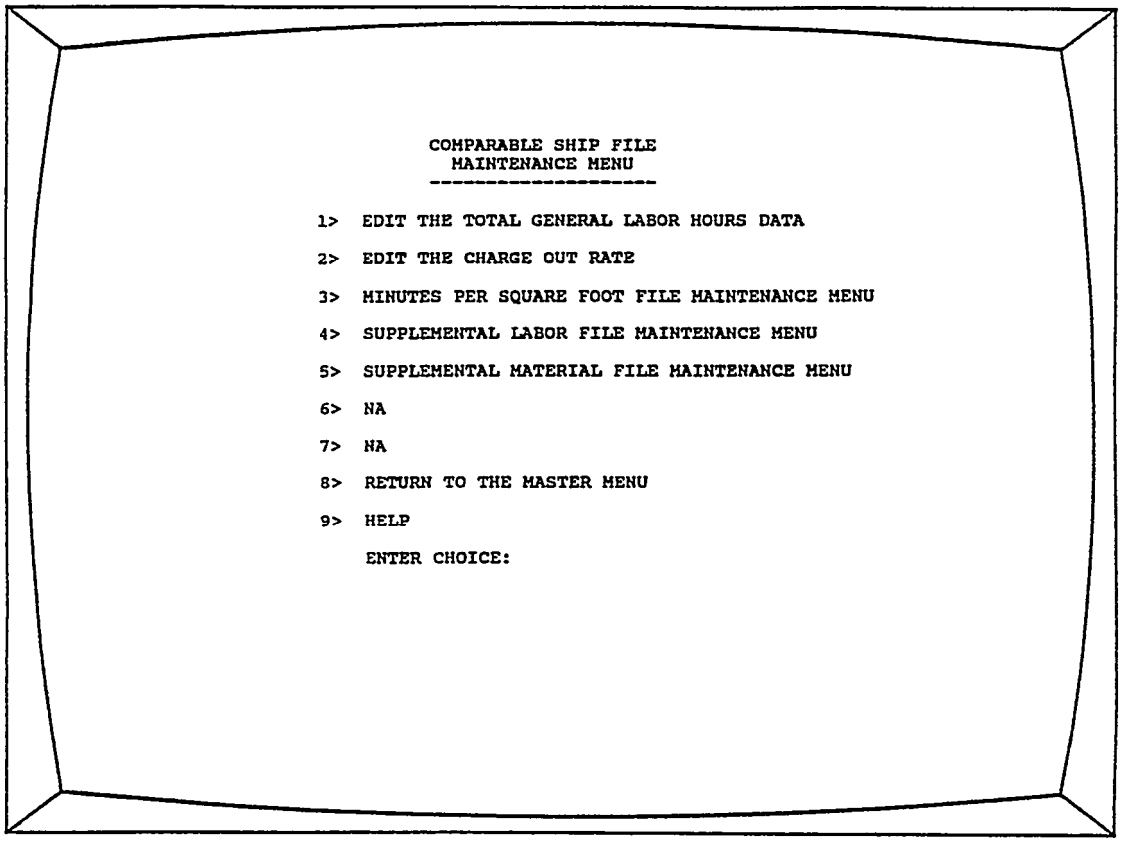



Figure 5-10.

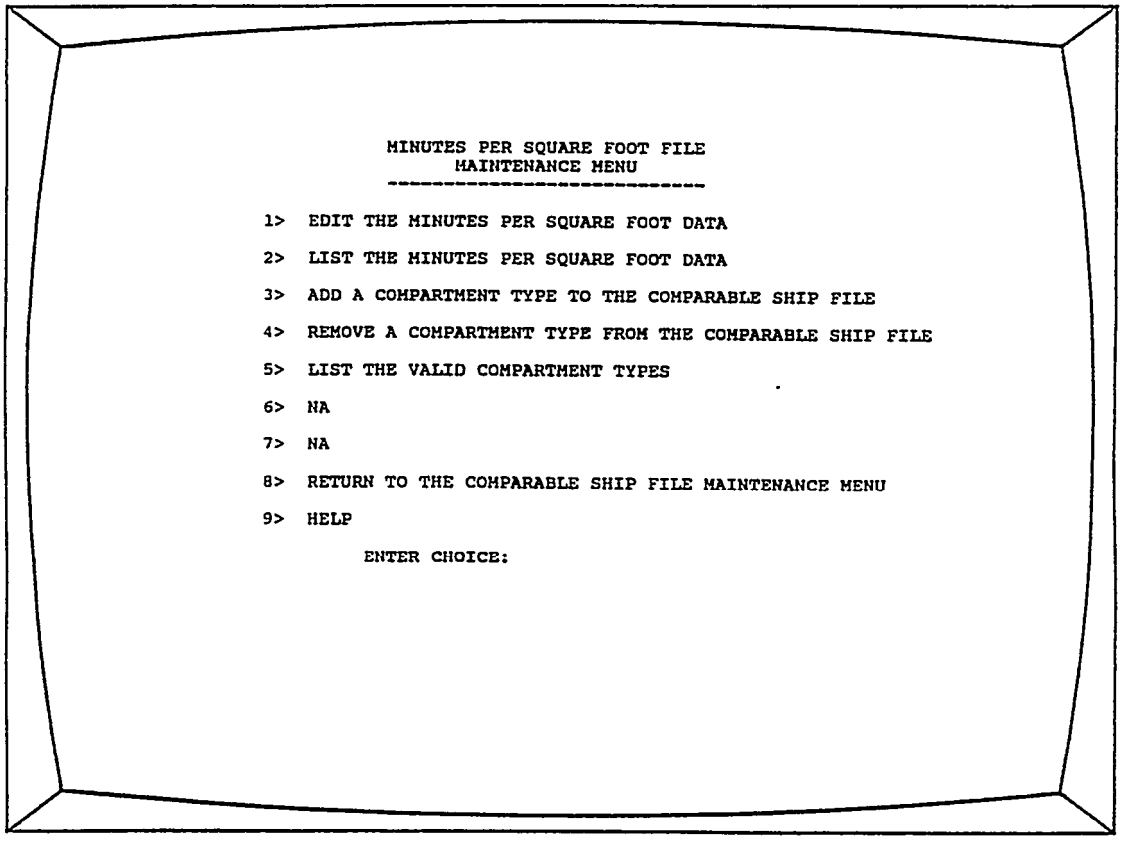



Figure 5-11.

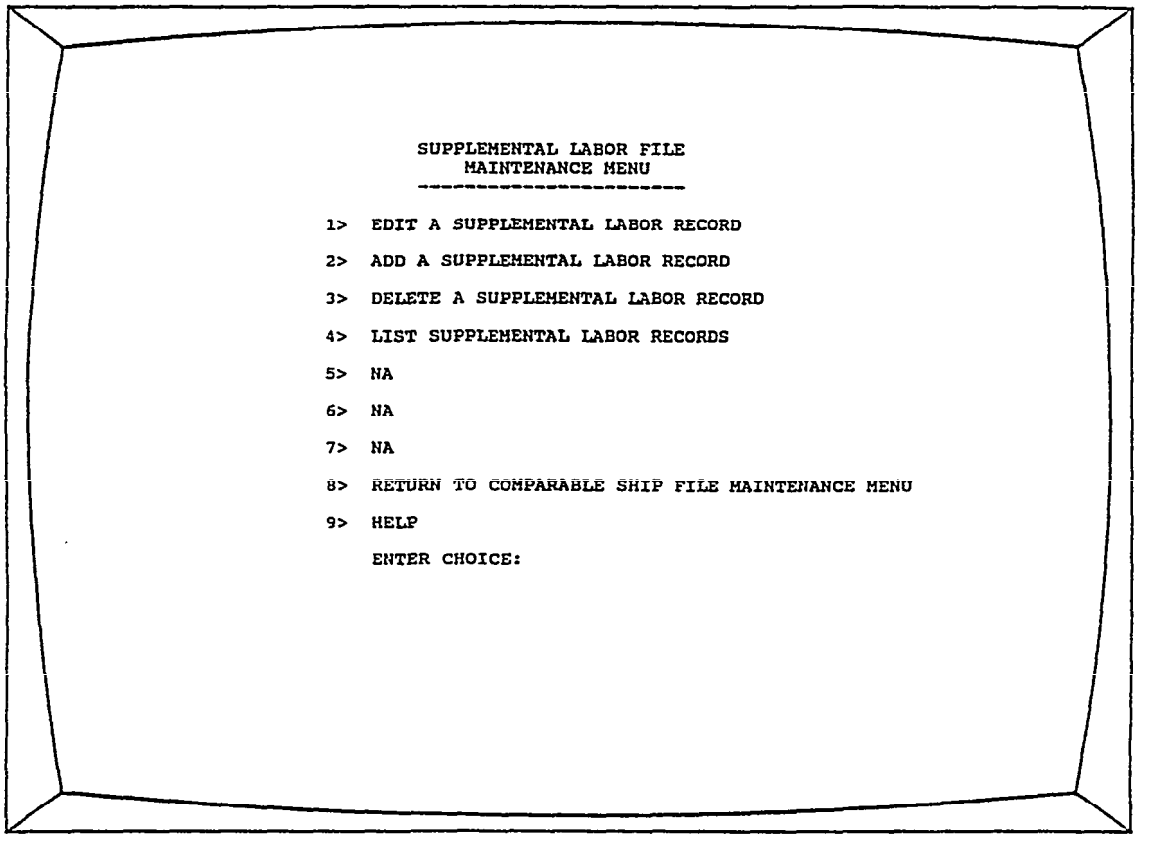
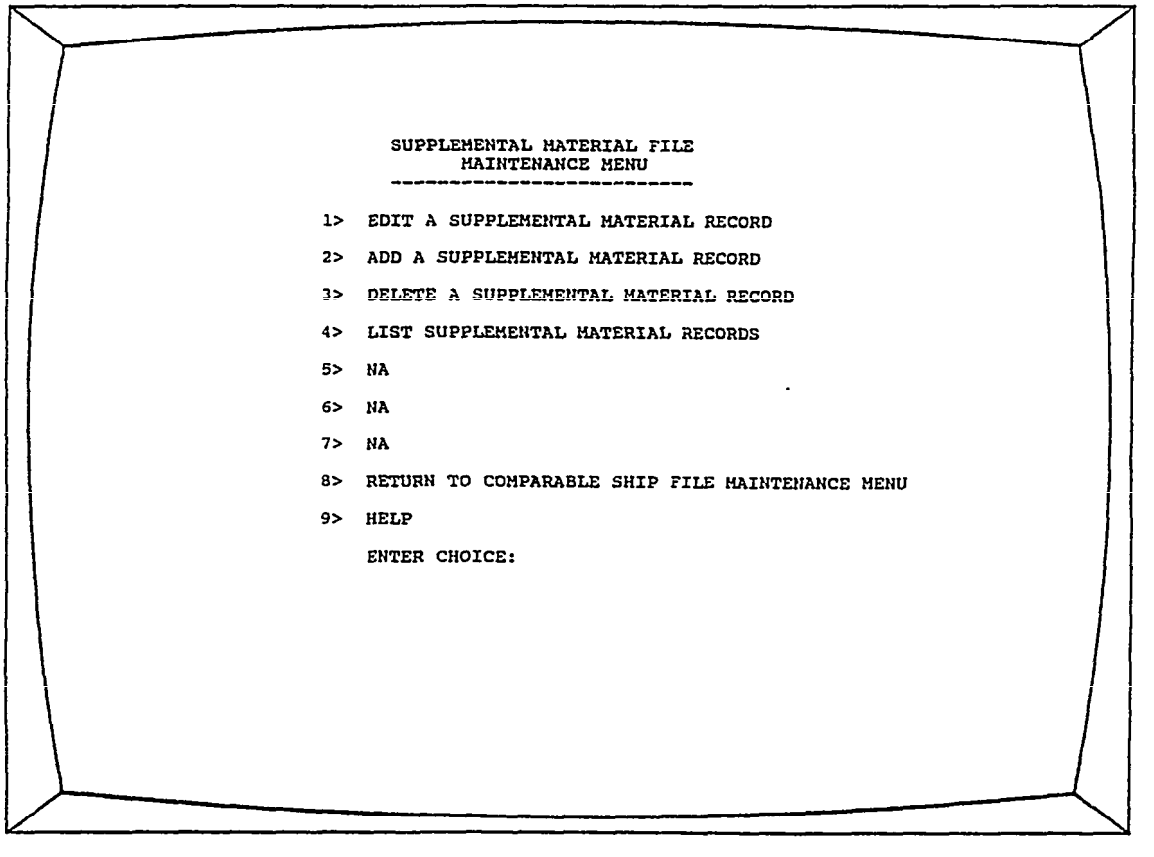

SUPPLEMENTAL LABOR FILE
MAINTENANCE MENU
1> EDIT A SUPPLEMENTAL LABOR RECORD
2> ADD A SUPPLEMENTAL LABOR RECORD
3> DELETE A SUPPLEMENTAL LABOR RECORD
4> LIST SUPPLEMENTAL LABOR RECORDS
5> NA
6> NA
7> NA
8> RETURN TO COMPARABLE SHIP FILE MAINTENANCE MENU
9> HELP
ENTER CHOICE:

Figure 5-12.


SUPPLEMENTAL MATERIAL FILE
MAINTENANCE MENU
1> EDIT A SUPPLEMENTAL MATERIAL RECORD
2> ADD A SUPPLEMENTAL MATERIAL RECORD
3> DELETE A SUPPLEMENTAL MATERIAL RECORD
4> LIST SUPPLEMENTAL MATERIAL RECORDS
5> NA
6> NA
7> NA
8> RETURN TO COMPARABLE SHIP FILE MAINTENANCE MENU
9> HELP
ENTER CHOICE:

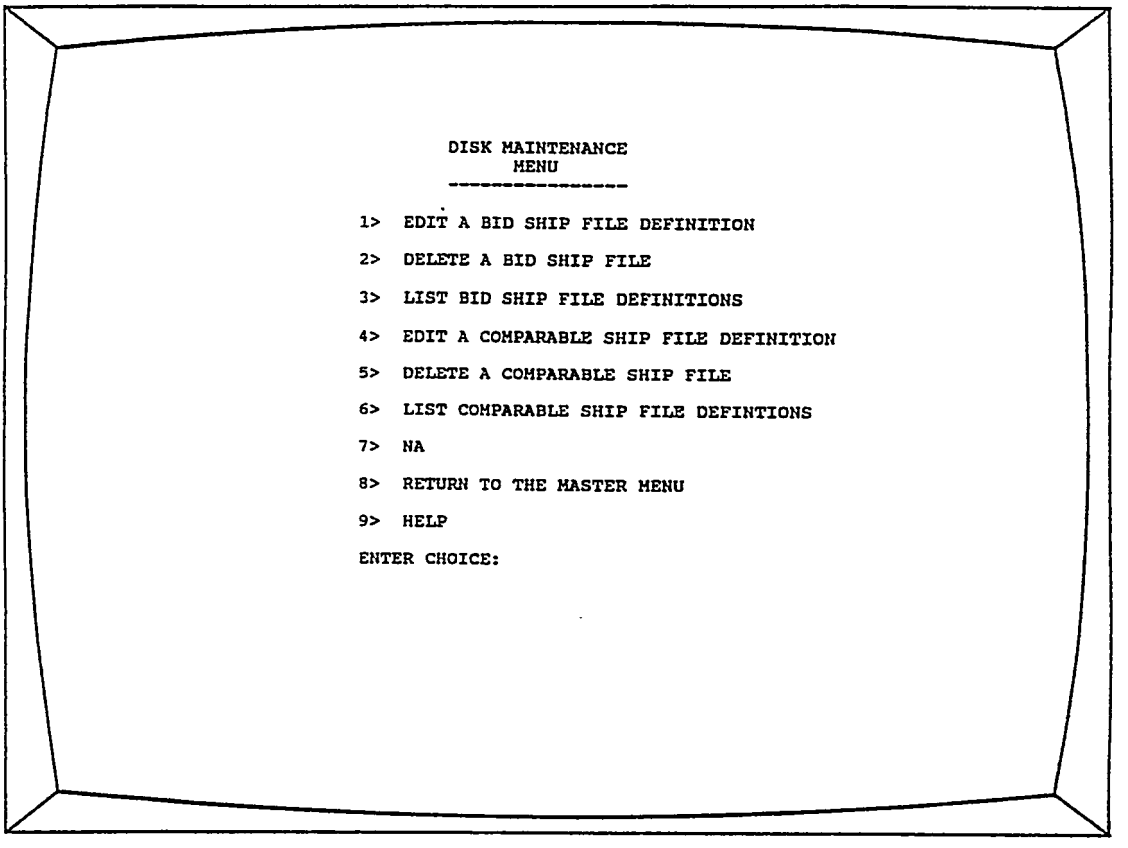

DISK MAINTENANCE
MENU
1> EDIT A BID SHIP FILE DEFINITION
2> DELETE A BID SHIP FILE
3> LIST BID SHIP FILE DEFINITIONS
4> EDIT A COMPARABLE SHIP FILE DEFINITION
5> DELETE A COMPARABLE SHIP FILE
6> LIST COMPARABLE SHIP FILE DEFINTIONS
7> NA
8> RETURN TO THE MASTER MENU
9> HELP
ENTER CHOICE:

Figure 5-14.